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1. Your reference — PAT 98407 GB

2. Patent application number *(The Patent Office will fill in this part)* — **9805736.7**

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

NOKIA MOBILE PHONES LIMITED
KEILALAHDENTIE 4
02150 ESPOO
FINLAND

Patents ADP number *(if you know it)* 05911995004

If the applicant is a corporate body, give the country/state of its incorporation — Finland

4. Title of the invention — "A SYSTEM FOR TRANSFERRING A CALL AND A MOBILE STATION"

5. Name of your agent *(if you have one)*

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

HELEN L HAWS (MRS)
NOKIA MOBILE PHONES
PATENT DEPARTMENT
ST GEORGES COURT
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SURREY GU15 3QZ UK

Patents ADP number *(if you know it)* 04105177001

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Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

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a) any applicant named in part 3 is not an inventor, or
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Description 35 + Annex 1 containing 15 pages

Claim(s)

Abstract

Drawing(s) ~~11~~ 18

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Signature HLHaws Date 18/3/98
HELEN L HAWS (MRS)
Agent for the Applicant

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A system for transferring a call and a mobile station

The present invention relates to a mobile station operating in a mobile communication network, which mobile station comprises connecting means for establishing a telecommunication connection and transferring information between a mobile station and a subscriber device connected to the telecommunication network over said telecommunication network.

In modern office work it is necessary to provide the employees with versatile information transfer connections which can transfer speech, facsimile messages, electronic mail and other data - usually in digital form. Transfer of information is needed inside an office or corresponding working environment for communication between employees, for transfer of information between branch offices of an enterprise, which offices can be in other towns or even in other countries, and for communication between the office and "outside world". In this text and all of the following text "office" stands for an environment with several users, which users "belong together", and which office physically covers a reasonably limited area. There has been a trend in the telecommunication branch toward integrated systems in which various forms of telecommunication can be controlled as one entity.

A conventional realization of an above mentioned type of office communication system comprises a company telephone exchange for providing telephone services and telephones connected to it over twisted-pair connections and a separate local area network (LAN) in which applications for advanced telecommunication services have been implemented and which has the intelligence to run them. The local network is connected to the telephone exchange using a telecommunication server (Telephony Server) which supports the traditional subscriber server architecture in which subscribers are subscribers' computers connected to the local network. For example call-, data-, facsimile-, electronic mail- and speech mail services are connected within an office utilizing the telecommunication server. In an integrated system users can also e.g. control telephone services using their computer terminals

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connected to the local network. The whole integrated office communication system is connected to public telephone network through the telephone exchange.

Figure 1 presents an example of a prior known office communication system in which users' telephones TP (TelePhone) have been connected by wire connections and a local area network (LAN) has been connected over a telecommunication server TS (Tele Server) into a telephone exchange PBX (Private Branch Exchange) which is connected to a public telephone network PSTN/ISDN (PSTN, Public Switched Telephone Network, ISDN, Integrated Services Digital Network). To the local area network (LAN) have been connected on one hand servers executing various services such as data base server DBS (Data Base Server), voice server VS (Voice Server) and electrical mail server EMS (Electrical Mail Server) and on the other hand the users' computers PC (Personal Computer). It can be regarded as a problem with this kind of realization that even if a user's telephone TP and computer PC usually are on the same table next to each other separate wire connections must be laid to the user's working room for them, on one hand from the telephone exchange PBX and on the other hand from the telecommunication server TS of the LAN. Building and maintenance of two overlapping telecommunication networks naturally causes cost.

The problem of overlapping telecommunication networks is increased by portable mobile stations utilizing radio connection coming rapidly more popular. Many persons working in an office need, because of their mobile work, a mobile station and often also a portable facsimile device and/or a combined portable computer/mobile station. In order to be able to use the devices based on radio connection also inside buildings, the constructions of which attenuate radio signals, it has been suggested that mobile radio networks should be supplemented with small base stations individual for offices or even for rooms, which base stations would be connected either directly or over wired telephone network to the central systems of mobile communication network. The network of small base stations would be already a third overlapping telecommunication network within the same office, and accordingly it is clear that in a preferable solution, which the present

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invention is aiming at, also the arrangement supporting radio communication stations should be realized using essentially the same means and telecommunication networks than the rest of the transfer of information in the office.

A challenge of its own to telecommunication systems is issued by the fact that work is done more and more in small-office or domestic environment, which is described by the concept SOHO (Small Office, Home Office). Even here advanced office communication services are often needed and it is particularly preferable if such a flexible system is available which can be utilized even both in the office and at home. The present systems which require overlapping connections for the utilization of mobile communication services, conventional telephone services and fast data transfer services are very inflexible for working in a small- or home office. In addition to above, the following kinds of solutions connected with integrated telecommunication systems are known from prior art.

EP publication 599 632 presents a wireless local network designed to replace the present kind of wired local networks (e.g. registered trade marks Ethernet and Token Ring) by a radio transfer network which forms inside an enterprise a private cellular system designed for data transfer. A network utilizing radio connection is, however, relatively expensive to realize and it is more sensitive to interference than a local network based upon wired connections. In addition to that it requires establishing of an extra radio network in addition to previous networks.

EP publication 462 728 presents an intelligent base station controller, subordinated to which at least one radio communication system base station is operating and which is capable of connecting calls from a certain mobile station coming through the base station directly to the wired telephone network. This system, however, requires said additional base stations, which increases the cost. The system is also, alike the system presented in publication 599 632, sensitive for external (radio)interference.

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If an integrated office communication system is realized utilizing traditional technique, separate wired connections must be laid into a user's working room on one hand from telephone exchange PBX (Figure 1) and on the other hand from telecommunication server TS of local area network (LAN). Constructing and maintaining two overlapping networks naturally brings extra cost. In said solutions according to prior art a solution to this problem has not actually been striven for.

A target of the present invention is to present a system which reduces the problems caused by overlapping networks. Additionally, the purpose of the invention is to reduce problems caused by wireless information transfer inside an office and extra cost. A further target of the invention is to present an arrangement, in which said system, integrating information transfer, can also serve home office- and small office users. A further target of the invention is to present an arrangement of said kind, in which the same devices can be used as terminal devices (e.g. mobile stations) in the telecommunication system both in the office and outside it.

Now a system has been invented for transfer of information, e.g. speech or data, in which the trunk of information transfer is inside the office a local network (e.g. local area network, LAN), and between office units e.g. a traditional telephone network utilizing wired connections or a fast data packet network utilizing ATM (Asynchronous Transfer Mode) technique.

In an information transfer system according to the invention the services normally provided by a telephone exchange and a telephone network have been moved to a local network to be provided by e.g. a server connected to the local network. Such services are e.g. internal calls within the enterprise. It is possible to perform the tasks of a traditional telephone exchange also in the traditional way, manually and personally, in which case it is possible to operate the telephone exchange using a terminal connected to the local network. Traditional telephones have been replaced with mobile stations according to the invention, which, while in the office, may be connected to a terminal device, typically a computer, either over a cable, an infrared connection, or low-power radio transceivers. In this case, the mobile station is

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connected to the telephone network through the terminal device, the local network and a specific telecommunication server. In this case the mobile station does not contact the telephone network using radio frequencies, not loading the mobile communication network, the possibly poor field strength inside the house does not inflict the quality of the connection, and no cost for using the mobile communication network radio channels is involved. If the mobile station according to the invention has not been connected to a terminal device (even if the user is in the office), the mobile station according to the invention operates like a traditional mobile station.

According to one embodiment of the invention the mobile station may be connected to the terminal device by means of a connection device, having a functional connection to the terminal device, and having means for connecting functionally to the mobile station. In response to connecting a mobile station to the connection device, the system will be informed to direct calls to the mobile station via the data communication network. The connection device can be a desktop stand or desktop charger and may be a separate device or integrated into the terminal device.

The system for transferring information according to the invention, comprises a mobile station operating in a mobile communication network, which mobile station comprises first connecting means for establishing a telecommunication connection and transferring information between the mobile station and a subscriber terminal connected to telecommunication network through said mobile communication network, and means for directing calls to the mobile station on basis of a first identifier via the mobile communication network, the system being characterized in that it further comprises a data communication network connected to the telecommunication network, a terminal device connected to the data communication network, second connecting means for connecting said mobile station into a functional connection with said terminal device, means for establishing a telecommunication connection and transferring information between said mobile station and said subscriber terminal through said terminal device and said data communication network, and means for directing calls to the mobile station on basis of a second identifier via said data communication network and said terminal device.

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The mobile station according to the invention comprises first connecting means for establishing a telecommunication connection and transferring information between a mobile station and a subscriber terminal connected to a telecommunication network through a mobile communication network, means for receiving calls on basis of a first identifier via the a mobile communication network, characterized in that the mobile station further comprises second connecting means for connecting the mobile station into a functional connection with a terminal device, which terminal device has a connection to telecommunication network and for establishing a telecommunication connection and for transferring information between said mobile station and said subscriber terminal through said terminal device, and means for receiving calls on basis of a second identifier via said terminal device.

A subscriber device means a terminal device connected to a telecommunication network, such as a telephone connected to a fixed telephone network, and a mobile station connected to a mobile communication network. A subscriber device also means servers and telephone exchanges connected to telecommunication networks, providing telecommunication services to the users of the telecommunication networks. In other words, a subscriber device means all the parts of a telecommunication network with which a telecommunication terminal device (e.g. a telephone) can communicate over a telecommunication network.

Embodiments of the present invention will now be described, by way of example, with reference to the accompanying drawings, of which :

figure 1 presents traditional communication networks and terminal devices used in an office environment;

figure 2 illustrates a wireless intranet office architecture according to an embodiment of the present invention;

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figure 3 illustrates a wireless intranet office architecture according to an embodiment of the present invention;

figure 4 illustrates the architecture of a mobile station and personal base unit of a wireless intranet office, according to an embodiment of the present invention;

figure 5 illustrates a general GSM intranet office concept;

figure 6 to 11 show information flow from terminals of a GSM intranet office according to an embodiment of the present invention;

figure 12 presents a system according to an embodiment of the invention for transferring information within a data transfer network and from the data transfer network to telecommunication networks;

figure 13A presents in more detail the structure of the various parts of the information transfer system according to an embodiment of the invention as a block diagram;

figure 13B presents connection of the mobile terminal to the terminal device using an intelligent charger;

figure 14A presents the functional blocks of a traditional mobile station as a block diagram;

figure 14B presents information transfer routes in a mobile station and a information transfer system according to an embodiment of the invention;

figure 15 presents the structure of a mobile station according to an embodiment of the invention, particularly components used for the power supply and

control of components used for establishing radio connection, and components required for connection to a terminal device; and

figure 16 presents in form of a diagram the forming of an information packet used for information transfer according to an embodiment of the present invention

Figure 2 illustrates a wireless intranet office architecture according to an embodiment of the present invention.

As can be seen, the wireless intranet office integrates an IP based private intranet environment with a public cellular network, in this case the GSM network. This allows cellular users to utilise private intranets to carry the cellular services (ie speech data SMS facsimile etc.) within the intranet coverage area. In addition, the wireless intranet office architecture provides a good platform for local multimedia extensions because it potentially offers higher bandwidth to the user. Access to public GSM network is offered by introducing a transparent location management method, which allows terminals connected to the intranet to be reached from the public GSM network in the normal manner. Thus, the wireless intranet office arrangement can be utilised to provide extra capacity in hot spot areas, such as airports, malls etc., where this might be needed.

In this wireless intranet office arrangement, the intranet forms a new kind of access network to the GSM network. The communication between the GSM backbone network and the end user access node takes place via internet protocol based networks instead of the GSM air interface, as will be seen below.

Figure 2 shows a mobile station 21 which, in one mode connects to a personal base unit 22 (eg either with a inter-connection cable, a infra-red connection, or with low power RF transmitter and receiver), and in another mode connects to a virtual GSM base transceiver station (BTS) 23. The mobile station 21 is connected to an IP local area network (LAN) and a home location register (HLR) and visitor location register

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(VLR) 25 and a mobile station controller (MSC) 26 by virtue of an inter-working unit (IWU) 24. This IWU comprises several network entities, including an intranet mobile cluster (IMC) GSM/IP Gateway 241, an intranet location register (ILR) 242, a WIO gatekeeper 243 and a WIO A-gateway 244.

Information such as data and/or speech may be transferred from the mobile station to the IP local area network by 2 routes, each of which includes a virtual BTS. In a first mode, the mobile station 21 is connected to the local area network via a personal base unit 22 (PBU), which itself comprises a virtual BTS. This is further explained with reference to figure 4 below.

In a second mode, the mobile station 21 forms part of a mobile cluster (for example see reference 32 in figure 3). In this case, the information is transmitted to the local area network via a virtual GSM BTS 23 dedicated to that cluster, and an IMC GSM/IP Gateway 241. The BTS transmits the signal over the A bis interface, and the IMC Gateway 241 performs a protocol transform from GSM to H323, so that the signal can be transmitted over the IP local area network. (As can be seen from this figure, the wireless intranet office architecture uses the H323 protocol for the signalling and data connections inside the inter-working unit).

The basic access interfaces to the cellular network are the air interface, the A-interface, the MAP protocol, the ISUP/TUP interface and the DSS.1 interface. The A-interface is an interface to mobile switching centre and the MAP interface is an interface to HLR/VLR. ISUP/TUP interface connects switching centres, while the DSS.1 interface resides in between of the BSX and switching center. The air interface connecting mobile terminals to the network can be any RF interface or infrared link. Candidate RF interfaces include e.g. Low Power RF (LPRF) and 802.11. Wireless LAN (WLAN). The air interface can also be replaced with a physical connection (e.g. RS-232 serial cable or Universal Serial Bus (USB). The GSM network sees this new access network as a BSS entity. New network entities are added to the access network to modify/de-modify cellular signalling. System

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design principle is to fulfil ITU-T's recommendation H.323 with in-build minimal set of cellular behaviour.

The WIO A-gateway 244 looks like a base station controller to the MSC 26.

A general WIO network architecture is shown in figure 3. A local area network 31 is provided with an internet mobile cluster IMC 32, an LPRF cell 34 and a landline connection 35. The IMC comprises a plurality of mobile stations, a virtual BTS (private GSM BTS) and a server in the form of an IMC GSM/IP gateway. The BTS interface between the BTS and IMC GSM/IP gateway is a GSM A-bis interface. The IMC GSM/IP gateway is responsible for signalling conversions between the GSM and H.323 protocols. The low power RF cell 34 comprises a personal base unit which has a virtual BTS and a low power transceiver, and associated mobile stations with corresponding low power RF transceivers. The PBU is directly connected to the WIO network. To provide the mobile stations with access to the GSM network, the PBU provides conversions between the GSM and H.323 protocols. These conversions can be seen as a bridge between cellular phone and H.323 features which support WIO location management and mobility features. The landline connection comprises a landline terminal 351 hardwired to a personal base unit 352, which in turn is hardwired to the local area network.

Also connected to the local area network are a WIO gatekeeper 36, which is responsible for the connection of mobile stations to within and outside the network. For example it might transfer a call from the server to an external system such as PSTN (via gateway 38) or it could provide connection to the IP network 37. The IP network, in turn, is connected to the operators local area network 39. This local area network is provided with an A-intranet gateway 391, an intranet location register 392 and IP telephony gateway 393.

Figure 4 shows the architecture of a mobile station 41 and a personal base unit, personal computer 42, according to a preferred embodiment of the present invention.

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The mobile station 41 and personal base unit 42 are represented showing layers 1 to 3 of the 7 layer OSI reference model, namely physical layer (layer 1), data link layer (layer 2) and network layer (layer 3). (These are data communication protocols whose purpose is to provide a link between 2 communicating devices).

Network layer 43 of the mobile station 41 provides call control management 431 (including supplementary services 435 and short message services 436). This layer also provides mobile management 432 and radio resource management 433. Further, it comprises a MUX which "switches" to a second branch of layer 2 to demand services of the data link (FBUS Ctrl 443) and physical layer (FBUS 452) when the mobile station 41 and the personal base unit 42 are "connected". In any event, the network laser demands the services of the data link layer 44 (data link 441 and control 442) and the physical layer 45 of the first branch, to allow the mobile station 41 to perform and report its measurements about the surrounding GSM network (neighbouring BTSs) and thus comply with GSM requirements.

Turning now to the personal base unit 42, this PBU comprises a phone driver implementing the physical and data link layers 48 and 47 (FBUS 481 and FBUS Ctrl 471). The network layer 46 of the PBU comprises a PBU control/IMC core control 462 and an H.323 protocol entity 463 which provide protocol conversion between GSM and H.323. The conversions are needed for GSM layer 3 signalling messages while the speech is carried as GSM coded in the whole while this intranet office network. The PBU further comprises TCP/IP entity 422 and a local area network adapter driver for the 23 for interfacing with the local area network. The PBU control 462 comprises a virtual BTS 49 for communicating with the network layer 43 of a mobile station 421.

The mobile phone also has a user interface 461.

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In the network, the mobile station interfaces the intranet mobile cluster and personal base unit entities. The interface to the personal base unit, as can be seen from figure 4, uses a modified GSM layer 3 (04.08) signalling.

The mobile station 41 and PBU 42 operate as follows.

When the mobile station 41 is outside the wireless intranet office environment, it operates as a normal GSM phone. The MUX 434 does not couple the radio resource management entity 433 with the second branch 443, 452. Voice and signalling is transmitted via the data link layer 44 and physical layer 45 over the first (GSM)branch to the cellular air interface.

Also, if the mobile station 41 is within the wireless intranet office, but forms part of an intranet mobile cluster, this same path is taken to the cellular air interface and the information and signalling is transmitted to the virtual GSM BTS of that cluster.

However, when the mobile station 41 is connected to a PBU 42 (for example by an RF 232 serial connection as indicated in figure 4) information such as voice, data, fax, SMS etc., is transmitted over the local area network. In this case, the MUX 434 demands the service of the second (LAN) branch layers 1 and 2, and layer 3 of the mobile station 41 is seen to communicate with the virtual BTS 49 of the PBU 42. That is, the information (eg. speech) and GSM layer 3 signalling messages are redirected to the second branch interface. As the mobile station 41 and the PBU 42 are linked, the field strength of the virtual BTS 49 will be greater than that of other BTSs in the GSM network. Consequently handover is made to the virtual BTS 49. After this, the handover signalling relating to this virtual BTS is handled from the MUX through the second branch. When handover has been made, the MUX handles all messages and forwards them to the new host cell through the RS 232 interface etc and "talks" to the other BTSs (as is conventional in GSM) over the first branch. General broadcast traffic is also seen by the mobile station 41, for example from layers 1 and 2 to the MUX and from there through the mobile station/PBU interface to the virtual BTS 49.

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While in this mode, the speech and layer 3 signalling are routed to the personal base unit, and the radio resource management entity at layer 3 remains connected to the GSM layer 2 (441), that is branch 1. As mentioned above, this is so that the mobile station can act as required by GSM (for example by measuring the RSSI for neighbouring BTSs etc.).

The parameters in the virtual BTS 49 within the IMC core are set in such a manner that the terminal is forced to remain clamped to this virtual GSM cell. This avoids possible handovers to any other GSM cells the mobile station might hear.

Figure 5 shows a general GSM intranet office concept, and figures 6 to 11 show information flow between terminals - figures 6 to 9 being within the office environment and figures 10 and 11 extending to outside the environment.

Figure 5 shows the GSM intranet office 57 comprising different terminal arrangements 51 to 54. The intranet office interfaces with an internet protocol network 58, which is partially situated within the office and partially at the operators location. The operator 59 controls transfer of information between the IP network 58 and network switching centres, such as mobile switching centres 55 and fixed line switching centres 56.

Terminal arrangements 51 and 52 comprise a mobile station 51a, 52a and a virtual BTS 51b, 52b. These mobile stations can be within an intranet mobile cluster or can be coupled to a personal base unit comprising of virtual BTS.

Figure 6 illustrates a call between mobile stations of the same office. In this case, the call might be sent by mobile station 51a to mobile station 52a. The information is transmitted from mobile station 51a to virtual BTS 51b and on to the LAN via the GIO inter-working unit. The local area network then transfers the information to virtual BTS 52b which in turn forwards it to mobile station 52a.

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Figure 7 shows a call between a mobile station 51a and an H.323 terminal 54 within the same office. Information transferred from mobile station 51a will be forwarded to the LAN in the same manner as in figure 6 (ie via BTS 51b and the GIO inter-working unit). The LAN then transfers the information to the terminal 54.

Figure 8 shows a call between a mobile station 52a and a fixed line extension 53a of a private branch exchange 53b of the same office. Again, information is transferred from mobile station 52a to a local area network via virtual BTS 52b and the office IWU. The information is then transferred over the local area network via a PSTN gateway to PBX 53b. This PBX then switches the information to the requisite extension 53a.

Figure 9 shows a call between a H.323 terminal and a PBX extension of the same office. In this case, there is no GSM connection. Information is forwarded to the local area network from the terminal 54 where it is transferred to PBX 53b via the local area network on a PSTN gateway. The PBX 53b then switches the information to the requisite extension 53a.

Figure 10 shows a call between a mobile station 51a of a GIO to the mobile network. In this case, information is transferred from mobile station 51a to the local area network via the virtual BTS 51b and the GIO inter-working unit. It is then transferred across the local area network and to a mobile switching centre 55 via an A-gateway.

Figure 11 shows a call between a mobile station 52a of a GIO and a fixed line network. In this case, information is transferred from mobile station 52a to the local area network via virtual BTS 52b and the inter-working unit of the GIO. The information is then transferred over the lan to a fixed line switching centre 56 via a PSTN gateway.

Figure 12 presents an example of an information transfer system according to the invention, comprising two telecommunication servers TCS (TeleCommunication Servers, Ref. 60, 61) controlling two sub-telephone systems 15, 16. Sub- telephone

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system 15 consists of two mobile stations 10, 11 and two terminal devices, to which mobile stations 10, 11 are connected e.g. either with interconnecting cable 51, or using infrared connection 52 (Figure 3A). It is also possible to use, instead of interconnecting cable 51 or infrared connection 52, low power transceiver units (not shown in the figure) operating at radio frequencies, of which one is placed in mobile station 10, 11 and the other in terminal device 40, 41. The information transfer media used between mobile station 10, 11 and terminal device 40, 41 does not essentially have an effect on the operation of the information transfer system according to the invention. The terminal devices 40 - 43 each comprise a virtual base transceiver station (VBTS) onto which the mobile stations 10 - 13 are respectively camped when they are connected to the terminal devices.

In this embodiment of the information transfer system according to the invention sub-telephone systems 15, 16 and telecommunication servers 60, 61 are connected to a data transfer network using nodes 70, 71. Nodes 70, 71 are interconnected using e.g. an ATM-packet network consisting of ATM-switch 80 and repeaters 81, 82, 83. The ATM-packet network is further connected to network server GTW (Gateway, Ref. 90), which is responsible for the connections of mobile stations 10 to 13 within the ATM-network and in particular for connections to outside of the ATM-network. Connections to outside the ATM-network are realized e.g. using mobile communication switching center MSC (Mobile Services Switching Center) 100 prior known from GSM (Global System for Mobile Communication) mobile communication system. From mobile communication switching center 100 a call is further transferred to an outside the system mobile station, e.g. traditional mobile station 14, through base station controller 104 (BSC, Base Station Controller) and base stations 105 (BTS, Base Transceiver Station). Alternatively, a call can be transferred from network server 90 further over traditional wired telephone network 110 (PSTN, Public Switched Telephone Network) or e.g. through digital multi-service network 130 (ISDN, Integrated Services Digital Network). A call means broadly a connection over telecommunication networks for transferring information between two terminal devices. In this context information means, except for calls, also among other things facsimile messages and GSM short-messages.

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In the information transfer system according to the invention as presented in Figure 12, information transfer connections based upon ATM and GSM technologies have been utilized. It is fully possible to utilize instead of these techniques other kind of information transfer connections. For example it is possible to arrange, instead of the ATM system, the information transfer connections between terminal devices 40 to 43, teleservers 60, 61 and network server 90 entirely e.g. using systems based upon Ethernet and Token Ring or future wide band networks. Correspondingly it is possible to realize, instead of GSM-system, an information transfer system according to the invention even in connection with other mobile communication systems, such as e.g. TDMA (Time Division Multiple Access), CDMA, W-CDMA AMPS (Advanced Mobile Phone Service) and NMT (Nordic Mobile Telephone) systems.

Figure 13A presents modules of mobile station 10, terminal device 40, telecommunication server 60, node 70 and network server 90. The structure of mobile station resembles that of a traditional mobile station, such as e.g. a GSM-mobile station. It comprises among other things processor 20 controlling the function of mobile station 10, signal processor 21 executing mainly time-critical operations, ASIC (Application Specific Integrated Circuit) -block 22, memory 23, D/A-converter 24, A/D-converter 25 and radio frequency part 30.

Mobile station 10 operates independently, that is when not connected to terminal device 40, exactly like ordinary mobile station 14. The functions performed by mobile station 10 have then been shared between processor 20 and signal processor 21 for example in such a way that processor 20 carries out mainly operations essential for communication between the mobile station and a base station requiring versatile processing, such as mobility management (e.g. change of base station), management of radio frequencies (transmission and reception frequencies) control of calls (handling of outgoing and incoming calls). Correspondingly, signal processor 21 executes shares requiring real time processing of incoming and outgoing signals, such as channel encoding and channel decoding,

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interleaving and de-interleaving, and ciphering and deciphering. Mobility Management, management of radio frequencies (Radio Resource Management), control of calls (Call Control), channel encoding (Channel Coding), interleaving and de-interleaving, ciphering and de-ciphering are functional blocks prior known to a person skilled in the art, the functional connection of which will be presented in following chapters in connection with the explanation of Figure 14A.

The presence of speech encoding and decoding in the operation of a mobile station is illustrated in the following, where, in order to make the invention understood, the operation of the transceiver of a cellular mobile communication system is explained. As an example, the transmitter and receiver functions of the European GSM-system based upon time division multi-use are explained referring to Figure 14A, which presents the block diagram of a mobile station transceiver according to GSM system. The transceiver of a base station differs from that of a mobile station usually by being a multi-channel one and having no microphone and loudspeaker, in other respects it is in principle similar to the transceiver of a mobile station.

The first stage of a transmission sequence is digitizing 1 of analogue speech and encoding 2. Sampling with A/D-converter 1 is carried out at 8 kHz frequency and a speech encoding algorithm assumes an input signal to be of 13 bit linear PCM. The samples obtained from the A/D-converter are segmented into 160-sample speech frames of 20 ms duration each. Speech encoder 2 processes the 20 ms speech frames, meaning that before the beginning of encoding, 20 ms of speech is taken in a buffer. The encoding operations are carried out individually for each frame or for subframes of theirs (in 40 sample blocks). As a result of the encoding by speech encoder 2, 260 bits are obtained out of one frame.

After speech encoding 2, channel encoding 3 is carried out in two stages, when to begin with (260 bits) part of the bits (50 most significant) are protected using block code 3a (= CRC, 3 bits) and after this these and the next most important bits (132) are further protected with convolution code 3b (encoding ratio 1/2) (50+3+132+4)*2 = 378, and some of the bits are taken unprotected (78). As shown in Figure 14,

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signaling- and logic messages come from control unit 19 controlling the blocks of the telephone, directly to block encoding block 3a, and naturally no speech encoding is done to these data messages. Correspondingly, at reception, the received signaling- and logic messages are taken from channel decoding block 115 to control unit 19. At block encoding 3a a queue of bits is joined at the end of a speech frame, with the help of which transfer errors can be detected at reception. At convolution encoding 3b the redundancy of a speech frame is enhanced. In all 456 bits are transmitted per each 20 ms frame.

These 456 bits are interleaved in block 4 and even interleaving 4 has two stages. At first, in block 4a, the order of the bits of a frame is shuffled and the shuffled bits are organized into eight blocks of equal size. The blocks are divided in block 4b further into eight subsequent TDMA frames, in which case the interleaved 456 bits are transmitted in eight time slots of the radio way (57 bits in each). The purpose of the interleaving is to spread transfers errors, which normally occur in error bursts, evenly over the whole transmitted data, in which way the channel encoding works most effectively. After de-interleaving an error burst is transformed into individual error bits which can be corrected at channel decoding. The next stage in a transmission sequence is data encryption 5. Encryption 5 is carried out using an algorithm which is one of the most guarded secrets of GSM. Encryption prevents unauthorized listening of calls, which is possible in analogue networks.

Encrypted data is formed 6 into a burst to be transmitted by adding into it a teaching sequence, tail bits and protection time. A burst to be transmitted is taken into GMSK-modulator 7 which modulates the burst for transmission. GMSK-modulation method (Gaussian Minimum Shift Key) is a constant-amplitude digital modulation method in which information is contained in changes of phase. Transmitter 26 mixes the modulated burst through one or more intermediate frequencies into 900 megahertz and transmits it through an antenna to radio way. Transmitter 26 is one of three radio frequency blocks 30. Receiver 28 is the first block of the receiving side and carries out functions inverse to transmitter 26. The third RF-block in synthesizer 27 which performs the generating of frequencies. GSM-system utilizes

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frequency jumping, in which transmission and reception frequencies are altered in each TDMA-frame. Frequency jumping improves the quality of a connection but sets strict requirements to synthesizer 27. Synthesizer 27 must be capable of moving from one frequency to another very quickly, in less than one millisecond.

At reception operations inverse to transmission are executed. After RF-receiver 28 and demodulator 111, bit detection 112 is carried out with e.g. a channel corrector, in which bits in received samples are detected, or in other words the transmitted bit sequence is tried to be found out. After the detection de-encryption 113 and de-interleaving 114 are carried out, and channel decoding 115 is performed on the detected bits and the error sums are checked using cyclic redundancy check (CRC, Cyclic Redundancy Check). At channel decoding 115 bit errors occurred in the transfer of the burst are attempted to be corrected. The 260 bit-long speech frame contains after channel decoding 115 the transmitted parameters describing speech, based upon which speech decoder 116 forms the digital samples of speech signal. The samples are D/A-converted 117 for reproduction with loudspeaker 32.

In the transceiver there is as the central controlling unit of the mobile station control unit 19 which essentially controls the above described blocks, coordinates their functions and controls timing. Control unit 19 comprises usually e.g. microprocessor 20 and ASIC-block 22. ASIC-block 22 takes care of the digital connection of the transmitted signal and the received signal. It comprises among other things buffer memories for transferring digital data to both directions (transmission/reception) and takes care of the digital modulation of data. ASIC (Application Specific Integrated Circuit) means an application specific integrated circuit which is manufactured in an integrated circuit factory to a customer's specification. In a mobile station ASIC-block 22 typically controls synthesizer 27, required clock signals 38, and controls power supply 39 together with processor 20. ASIC-block 22 is connected with D/A (Digital to Analog) -converter 24 and A/D (Analog to Digital) -converter 25 to radio frequency section 30.

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Mobile station 10 communicates with the user utilizing user interface unit 31 (Figure 13A, UI, User Interface) which comprises among other things loudspeaker 32, microphone 33 and a display (not shown in the figure). User interface unit 31 comprises also A/D-converter 1 for transforming a microphone signal into a digital form and D/A converter 117 for forming a loudspeaker signal, and required amplifiers. Mobile station 10 also comprises SIM (Subscriber Identification Module)-intelligence card 34 prior known to a person skilled in the art, which card contains among other things the user's telephone number.

In this embodiment of the information transfer system according to the invention it is possible to connect mobile station 10 and terminal device 40 to each other in a number of methods. One of the methods is to interconnect the devices using a mechanical wire connection using interface units IU (Interface Unit, Figure 13A, references 35 and 49). The interconnection interface can be e.g. a serial port. The advantage of a physical wire connection is among other things safe operation and the logical use, because a user directly sees whether mobile station 10 is connected to terminal device 40 or not. Another method of connecting mobile station 10 to terminal device 40 is to use e.g. wireless transfer 52 carried out in infrared wavelength range. A very common, and suitable for the purpose, data transfer protocol is IrDA (Infrared Data Association) -protocol prior known to a person skilled in the art. In this case data transfer 52 taking place in the infrared wavelength range is realized between infrared transceivers 36 and 48. It is also possible to realize the connection using low-power radio frequency transceiver units (not shown in the figure).

In figure 13B there is shown an alternative way of connecting mobile station 10 according to the invention to terminal device 40. The connection is carried out by means of a connection device 140. This connection device 140 can be a cradle such as a desktop stand or desktop charger. Here, by way of example, the connection device is described by means of a charger called intelligent charger 140. The intelligent charger 140 is connected releaseably to terminal device 40 with physical

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conducting wire 141 and interface unit 142. Using same interface unit 142 and conducting wire 143 the intelligent charger 140 is also connected releaseably to mobile station 10 when mobile station 10 has been installed to intelligent charger 140. Conducting wires 141 and 143 form a bus for communication between terminal device 40 and mobile station 10 via intelligent charger 140. The connections illustrated by conducting wires 141 and 143 may as well implemented in other ways, e.g. by infrared connection or by electrical connectors or the connection device 140 may be integrated into the terminal device 40. Possible signalling between terminal device 40 and mobile station 10 in establishing the connection therebetween can be carried out using Hayes AT-commands (a de facto standard) under control of the processors 20, 45 of each of the devices. The control in the terminal device 40 for establishing a connection to the mobile station 10 and after an established connection is handled by the processor 45. Such control operations can be implemented as an application software 144, which is executed by the processor. Interface 142 of intelligent charger 140 also includes means for arranging the charging voltage from power supply 145 to battery 147 of mobile station 10 via conducting wire 146. If the connection device 140 has no own power source, it can get and transfer power to the mobile station from the terminal device 40.

Terminal device 40 may be e.g. a PC prior known from office environment or a workstation, which comprises among other things processor 45, memory 46 and network interface unit 50 (NI, Network Interface) for connecting terminal device 40 to local area network (LAN)(references 53 and 65). Nodes 70 and 71 are components prior known from ATM technique, the purpose of which is to transfer information between LAN (references 53, 65) and "the world outside". Nodes 70, 71 carry out the required protocol transforms, in this case the transforms from LAN-protocol to ATM-protocol. Nodes 70, 71 comprise among other things interface unit 71 for connection of node 70 to LAN-network 65, interface unit 72 for connection of node 70 to ATM-network 65, and processor 73 controlling the operation of node 70. Node 70 also comprises memory 74 used among other things for buffering the data to be transferred. Telecommunication servers 60, 61 are traditional network servers and

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telecommunication server 60 comprises among other things processor 63, memory 62 and network interface unit 64 for connection to LAN-network 65.

The information transfer system according to the embodiment of the invention is connected for example to mobile telephone exchange 100 over network server 90. Network server 90 has been designed to maintain the status data of mobile stations 10 to 13 belonging to the system and to control the operation of telecommunication servers 60, 61. If required, network server 90 can take over the functions of telecommunication servers 60, 61, e.g. if a fault occurs. Correspondingly, telecommunication servers 60, 61 have been designed in such a way that, if required, they can take over the responsibility to maintain the system, either one of them alone or various functions can be shared between telecommunication servers 60, 61. A network server comprises among other things processor 92, ATM-interface unit 91, memory 93 and interface unit 95 for connecting the device to mobile telephone exchange 100. In systems with highest degree of integration it is possible to concentrate the functions of telecommunication servers 60, 61 and network server 90 in one of terminal devices 40 to 43, in which case separate servers 60, 61, 90 are preferably not required.

When mobile station 10 is connected to terminal device 40 in a way characteristic of the invention, e.g. using interconnecting cable 51 or infrared connection 52, it operates in a different mode. As mentioned with regard to figure 4, the radio frequency section 30 is used for certain GSM BTS information requirements etc. However layer 3 GSM signalling and the information is forwarded to the terminal device for transmission over wire connections. Switching is detected by both terminal device 40 and mobile station 10 and, depending on the switching method used, switching can be detected in a number of methods. When e.g. multi-core interconnecting cable 51 is used, one of the cores can be allocated for the indication signal. If e.g. in terminal device 40 said indication signal is connected to operating voltage (e.g. + 5 V), mobile station 10 detects the switching in of mobile station 10 by monitoring the voltage level of the indication signal e.g. using level detector 37A (Figure 5). Level detector 37A transfers the information e.g. over

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internal bus 200 to processor 20 controlling the system, controlled by which mobile station 10 and terminal device 40 go over to using wired information transfer connection over cable 51. A physical connection within mobile station 10 is established when processor 20 orders switch K3 to close. For example in order to save power, processor 20 can in this case switch off infrared transceiver 36 by opening switch K4 (if it was closed). In a corresponding way terminal device 40 can detect connecting to mobile station 10 by monitoring an indication signal of same type, the signal level of which a program installed in terminal device 40 polls in interface unit 49 at certain, predetermined intervals. Because said computer program executed in processor 45 and memory 46 can be run in the background, it does not have an essential effect in the other operation of terminal device 40. When the cable between mobile station 10 and terminal device 40 is disconnected, the processor of terminal device 40 detects the disconnection from interface unit 48 and processor 20 of mobile station 10 from interface units 35 using detector 37A. The connection can also be switched off manually from the user interface of terminal device 40 or from the user interface of mobile station 10.

If the connection between mobile station 10 and terminal device 40 is realized using an infrared connection, there also is a number of ways for detecting the connection. When the common IrDA (Infrared Data Association) protocol is used, connecting is detected e.g. based upon IAS (Information Access Service) -service, obligatory for devices according to IrDA standard, using detector 37B. IAS-service means a handshake operation between a device (in this application mobile station 10) and a server (in this application terminal device 40) in which a device can ask a server about services available. The most important information transferred at handshake is LSAP ID (Link Service Access Point), which defines the connection point at which the required service is available. It is this information that is required for a successful establishing of a contact. Processor 20 selects IrDA-connection 52 by closing switch K4. The wire connection is disconnected if required with switch K3. When infrared connection 52 is used, disconnection of connection 52 is detected correspondingly using infrared transceivers 36 and 48. If the connection is established using low-power transceiver units operating on radio frequency, the

establishing and disconnection of a connection takes place according to same type of principle.

If the connection between mobile terminal 10 and terminal device 40 is established using intelligent charger 140, the processor 45 (executing the application software 144) of terminal device 40 is monitoring the establishment of the connection. The processor 45 checks periodically whether mobile station 10 has been installed to intelligent charger 140 or not. Alternatively the detecting of the establishment of the connection can be carried out by mobile station 10. In both alternatives this can easilly be done e.g. by monitoring the voltage of a pin of a connector as was described above in relation to the embodiment without a separate connection device 140. After the connection has been established, mobile station 10 sends an information message to terminal device 40, in which it informs about the connection to intelligent charger 140. The terminal device 40 may acknowledge receipt of this message. Once connection is established call transfer is performed according to the invention. For example, when the terminal device is ready it sends via the intelligent charger 140 a call transferring order to mobile station 10, and the mobile station 10 performs the call transfer via the mobile network and sends a confirmation message to terminal device 40 on completion.

The following is the description of the operation of one embodiment of the information transfer system according to the invention when mobile station 10 has been successfully connected to terminal device 40, either using cable 51, infrared connection 52 or a pair of low-power radio transceivers. In this embodiment, in order to that servers 60, 61, 90 can route calls (or other data in digital form, such as e.g. SMS- short messages) from mobile stations 10 to 13 connected to terminal devices 40 to 43 within the information system or from the information system to mobile communication switching center 100 or to fixed public telephone networks 110, 130, servers 60, 61, 90 know telephone numbers 56 of each mobile station 10 to 13, and also the terminal device 40 to 43 in which they are connected. For the transfer of this information the information transfer system according to this embodiment, specific information packet 47 is used, which in the figures is

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abbreviated as SIAWSII (Specific Internet Address With Subscriber Identification Information). Information packet 47 is formed in the memory of terminal device 40, from which it is transferred further to servers 60, 61, 90 of the information transfer system. The following is a description of the forming of information packet 47 with reference to Figure 6.

In the first stage (Ref. A, Figure 16) processor 45 of terminal device 40 transmits to mobile station 10 a request to transmit the identification information stored in SIM (Subscriber Intelligent Module) intelligence card 34. This identification information essentially contains telephone number 56 of mobile station 10. Processor 20 of mobile station 10 forwards telephone number 56 from SIM-card 34 to processor 45 of terminal device 40, which saves it in memory 46. A part of memory space of its own in memory 46 has been allocated to information packet 47, of which space areas of their own have been reserved among other things for telephone number 56.

SIM-card 34 contains, in addition to telephone number 56, even information field 57 in which various kinds of information is stored. Some of this information is such which has been defined in GSM-standard and which is automatically stored by GSM-system and which a user cannot alter. An example of this kind of information is a list of available teleoperators, based upon which list a user can select the operator he wants, typically when traveling abroad. An important part of information field 57 of SIM-card 34 is also the part a user can use for e.g. storing telephone numbers and names. This makes it possible, among other things, that when SIM-card 34 is moved from one mobile station to another, the telephone numbers and names saved by a user himself are also moved without reprogramming them. It is possible to use information field 57 even for saving service specific settings. If some information saved in information field 57 is needed by servers 60, 61, 90, this information is included in the second stage (Ref. B) in information packet 47 by processors 20 and 45. If it is not known in advance whether any information contained in information field 57 is needed by servers 60, 61, 90, the whole information field 57 of SIM-card 34 can naturally be saved as a default value in information packet 47.

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Terminal device 40, like e.g. all computers belonging to public telecommunication networks, has its own, individual TCP/IP (Transmission Control Protocol / Internet Protocol) -address. Based upon these TCP/IP-addresses different types of servers (including servers 60, 61, 90) are capable of routing messages between terminal devices connected to the network. Figures 13A and 16 present network interface 50 of terminal device 40, by means of which terminal device 40 is connected to LAN-network 53. TCP/IP-address 58 (Figure 16) has for clearness been presented in connection with network interface 50, even if it normally is physically stored in memory 46 of terminal device 40. In the third stage of forming information packet 47 (Figure 16, Ref. C) processor 45 of terminal device 40 saves TCP/IP-address 58 of terminal device 40 in the space allocated to it in memory packet 47.

In the information system according to this embodiment, the terminal device 40 transfers information packet 47 it has assembled further to telecommunication server 60 through local network 53, 65 (Figure 13A). Telecommunication server 60 registers information packet 47 in its memory 61. Based upon this information packet 47 teleserver 60 knows among other things that mobile station 10 is connected to terminal device 40 having a certain TCP/IP-address 58 and what is the telephone number 56 of said mobile station 10. Telecommunication server 60 transfers information packet 47 further to network server 90 over e.g. ATM-network (references 72, 81, 80, 82, 91 describe components used for the transfer). Network server 90 registers information packet 47 in its memory 93. If mobile station 11, 12, 13 is connected to other terminal devices 41, 42, 43 of the system, they are automatically registered though information packets 47 in the memories of teleservers 60, 61 and network server 90 in a corresponding way. The arrangement is essentially hierarchic, meaning that teleserver 60 registers the TCP/IP-addresses 58 and the identification information of mobile stations 10 and 11, and telecommunication server 61 correspondingly those of mobile stations 12 and 13. Network server 90 in its turn registers mobile telephones 10 to 13 registered in telecommunication servers 60 and 61, that is all mobile stations 10 to 13 registered in the system. If problems occur it is however possible to change the hierarchy and

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telecommunication servers 60, 61 can cater for the tasks of network server 90 and vice versa. In an integrated and most flexible information transfer system according to this embodiment of the invention it is possible to move the tasks of telecommunication servers 60, 61 and network server 90 to be performed by terminal devices 40 to 43. Network server 90 is connected to mobile communication switching center 100 or to telephone exchanges 110, 130 of fixed networks over wired connections 120, 121, 122. It is possible to realize said wired connections 120, 121, 122 e.g. as 2.048 Mbps PCM-transfer connections which provide 30 pcs. of 64 kbps information transfer channels each. In the preferable embodiment of the mobile communication network according to the invention each 64 kbps information transfer channel has been allocated an individual telephone number of its own in the exchanges. Based upon information packets originated in mobile stations 10 to 13 and saved in network server 90, network server 90 knows the mobile station telephone numbers 56 of mobile stations 10 to 13 according to the invention, and whether they are connected to terminal devices 40 to 43 of the system or not. Based upon this information processor 92 of network server 90 generates, if required (when a mobile station is connected to terminal device 40 to 43 and the information about this has been transferred to network server 90) a call transfer message with which it informs mobile communication switching center 100 that in future calls arriving to said mobile station telephone number shall be transferred to a certain telephone line connected to network server 90, instead of radio way. A call transfer message is a message prior known to a person skilled in the art, which even private persons can in general use in their own telephones if they are connected to a digital telephone exchange. After transferring the call transfer message to mobile communication switching center 100 processor 92 of network server 90 directs calls arriving to said telephone line through servers 60, 61 and terminal devices 40 to 43 further to the correct mobile station 10 to 13. After this mobile station 10 to 13 operates like a telephone in fixed telephone network, and radio parts typical for a mobile station need not be used. Telephone exchanges 100, 110, 130 operate as normal and no functional changes need be made in existing telephone exchanges 100, 110, 130. When mobile station 10 to 13 according to the invention is disconnected from terminal device 40 (or the connection is otherwise broken)

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processor 45 of terminal device 40 sends a message to telecommunication server 60 and further to network server 90, which delete the registering of mobile station 10 (information packet 47) from their memories 61, 93. In addition to this processor 92 of network server 90 further sends a message to mobile communication switching center 100 for canceling of the call transfer, and the logic wire connection between mobile station 10 and mobile communication switching center 100 is canceled entirely. Simultaneously when the connection from mobile station 10 to terminal device 40 is cut off, radio frequency part 30, ASIC-block 22 and signal processor 21 are activated to normal operating state by processor 20 of mobile station 10 through power supply unit 39 and clock generator 38. After this mobile station 10 seeks the best base station 105 in the normal way and transmits by radio through base station 105 and further through base station controller 104 its registration to the mobile communication network in the normal way. After this mobile station 10 according to the invention can transmit and receive messages through base station 105 like normal mobile station 14.

The call transfer may be performed differently compared to what is described above, especially when a connection device 140 (e.g. an intelligent charger) is used. This will be described in following. When terminal device 40 detects that the mobile station 10 has been connected to intelligent charger 140, terminal device 40 orders the mobile station 10 to make a call transfer to the IP address of terminal device. The signaling of the call transfer is done according to a standard characteristic to mobile station 10, like the signaling according to GSM-standard. In this case the call transferring message is transmitted to the mobile switching center 100 via mobile communication network without the need of the use of local area network 53, 65, telecommunication servers 60, 61 and network server 90 for the update of the location information of the mobile terminal. All the incoming calls are routed via network server 90, telecommunication servers 60, 61 and local area networks 53, 65. Calls out from mobile station 10 can be performed either via the same route or wirelessly via mobile communication network in a normal way, on basis of the desire of the user of the mobile station 10. In this embodiment of the invention there is no

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need to close the radio parts of the mobile station, because of the possibility of charging the battery 147 all the time via conducting wire 146.

When mobile station 10 is disconnected from intelligent charger 140, both the processor 45 of the terminal device 40 and the mobile station 10 will detect it. On that moment the mobile station cancels the call transferring automatically by sending, e.g., a call transfer canceling message according to GSM standard via mobile communication network to mobile switching center 100.

The above discussion refers to a situation in which calls arriving at mobile station number 56 of a certain mobile station 10 are transferred over fixed telephone lines and data transfer networks (ATM, LAN) through terminal devices 40 to 43 further to terminal device 10 to 13 when mobile station 10 is connected to terminal device 40. This arrangement suits excellently situations in which mobile station 10 is mainly used as a normal mobile station outside office. In this case every arriving call is a mobile call, which typically the receiver (the user of mobile station 10) has to pay for. Extra cost can also be caused by outgoing calls, even if they in this information transfer system according to the invention are transferred without any information transfer by radio. The cost depends on the operators' price policy.

Another embodiment of the information transfer system according to the invention is better suited for situations in which mobile station 10 is used mainly connected to terminal device 40. In this case it is possible to reserve a telephone number in the fixed telephone network for each mobile station 10 to 13 and connect the lines permanently to a network server. Accordingly, mobile station 10 to 13 is used under the number of the fixed telephone network always when it is connected to the terminal device. If mobile station 10 to 13 is now disconnected from the terminal device, processor 92 of network server 90 generates a call transfer message to telephone exchange 110, 130 of the fixed telephone network, in which message it informs that in future calls (or other information) arriving to said line of fixed telephone network shall be transferred to the mobile telephone number 56 of mobile station 10 to 13 according to this embodiment of the invention. With this method

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mobile station 10 to 13 operates at the rates of the fixed telephone network always when it is connected to the terminal device. When mobile station 10 is reconnected to the terminal device, processor 92 of network server 90 sends a call transfer canceling message to telephone exchange 110, 130.

In the case of mobile communication switching center 100 location data and call transfers are stored in memory means 101 of mobile communication switching center 100, which means contain among other things subscriber register 102 (SDB, Subscriber Data Base) and a visitor register (Visitor Data Base). When processor 92 of network server 90 has successfully performed a call transfer, e.g. from mobile station number 56 of mobile station 10 to the temporary number allocated to it, it is possible to transfer an acknowledgment message to that effect to mobile station 10. The acknowledgment message is transferred, based upon the TCP/IP-address through network 91, 82, 80, 81 and local network 53 to terminal device 40, which in turn transfers the information to mobile station 10 connected to it over selected information transfer media (51, 52). Alternatively it is possible to transfer a message in case a call transfer is not successful, in which case mobile station 10 assumes that the call transfer was successful if said message has not arrived within a certain, predetermined time.

After stating a successful registering and a call transfer, e.g. based upon said acknowledgment message, processor 20 controlling the operation of mobile station 10 switches off among other things radio frequency part 30, because in future the transfer of calls is carried out through terminal device 40, as explained in more detail later on. In this embodiment of mobile station 10 according to the invention processor 20 switches off the power supply to radio frequency part 30 by switching off the power supply from power supply 39 with switch K7 (Figure 5). Switching off the radio frequency parts eliminates problems caused by wireless information transfer within the office, such as interference and blocking situations eventually met by several users in a limited area, and avoids extra cost inflicted by the use of radio network. In addition to switching off the radio frequency parts 30, the processing capacity required by mobile station 10 is reduced, and particularly clock signals of

MAR. 98(WED) 15:18 NMP PATENTS UK FAX:00 44 1276 677720 P.033
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signal processor 21 and ASIC-block 22 can be reduced or even temporarily be stopped entirely. Processor 20 controls the clock signals by controlling the operation of clock generator 38. If the services provided by signal processor 21 and the ASIC-block are not required at all, it is possible to switch off the power supply using switches K5 and K6. Together these operations reduce the need of power of mobile station 10 decisively, and accordingly the operating time of mobile station 10 according to the invention is long when connected to terminal device 40, even up to several weeks or months. If mobile station 10 is connected to terminal device 40 using connecting cable 51, it is possible to arrange even a charging voltage in connection with the connecting cable, in which case the battery (not shown in the figure) of the mobile station is charged when it is connected to terminal device 40.

The following is a description of the establishing of a connection and of information transfer between mobile stations 10 to 13 and mobile station 14 in certain exemplary cases. If the user of mobile station 10 (A-subscriber) of mobile station 10 registered in telecommunication server 60 and network server 90 calls a number (B-subscriber), processor 20 of the mobile station transfers this information and said number through terminal device 40 to telecommunication server 60. Telecommunication server 60 checks, based upon information packets 47 registered in its memory 61, whether the called number (B-subscriber) is registered in telecommunication server 60. If this is the case (as e.g. if B-subscriber is mobile station 11 connected to terminal device 41), the telecommunication server transfers the TCP/IP-address of B-subscriber to terminal device 40. Based upon this information terminal device 40 can establish, using TCP/IP-protocol, a connection through local network 53 to terminal device 41 belonging to sub-telephone system 15. When the connection is established, mobile stations 10, 11 connected to terminal devices 40, 41 can communicate with each other, or transfer e.g. speech or data, through local are network (LAN). This corresponds functionally to an internal call within a company, which traditionally would have been realized in a private telephone exchange.

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The encoding of speech can be carried out using e.g. the coding method based upon RPE-LTP (Regular Pulse Excitation - Long-Term Prediction) -technique according to ETSI- (European Telephone Standard Institute) standard, prior known e.g. from GSM-mobile telephones, which technique is used also in speech transfer by radio. It encodes the speech to 13 kbps line speed. In this case the speech to be transmitted is transferred from speech encoder 2 (Figure 4B) through switch K1 controlled by processor 20 to internal bus 200, not to channel encoding block 3, which would be the procedure if the speech would be transferred by radio. From internal bus 200 the outgoing speech is transferred through switches K3 and K4 controlled by processor 20 either to interface unit 35 or 36, and further to terminal device 40. Speech received from interface units 35 or 36 is transferred respectively through switches K3, K4, K2 controlled by processor 20 to speech encoder 116 and further through D/A-converter 117 to loudspeaker 32. It is also possible to use any other encoding method, such as ADPCM- (Adaptive Differential Pulse Code Modulation) encoding. In this case RPE-LTP-speech codecs 2, 116 are not needed and instead of them, speech can be transferred even directly from A/D-converter 1 to internal bus 200, and correspondingly from D/A-converter 117 to internal bus 200. In Figure 4B this is illustrated using dashed lines. The speech encoding standard used does not require structural changes in the information transfer system according to the invention. It is also possible to use different speech encoding standards in the opposite directions and a connection even need not be a two-way connection. When some other digital information is transferred to interface units 35 or 36 instead of speech, it also takes place from internal bus 200 through switches K3 and K4 controlled by processor 20.

In the above described system terminal devices 40 and 41 transferred information through the local network directly between each other. Another alternative for establishing a connection is that telecommunication server 60 acts as an information intermediary between mobile stations 10 and 11 just like a telephone exchange, in which case mobile stations 10 and 11 have no direct connection.

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If B-subscriber is not registered in sub-telephone system 15 of telecommunication server 60, it sends the number of B-subscriber further to network server 90. Network server 90 checks then based upon information packets 47 registered in its memory 93 whether B-subscriber has registered in any other sub-telephone system 16 of some other telecommunication server 61 of the information transfer system. If this is the case, network server 90 transfers the TCP/IP-address (saved in information packet 47) of B-subscriber to A-subscriber, in which case the establishing of connection between terminal device 40 and terminal device 42, 43 belonging to sub-telephone system 16 takes place in a way corresponding to the establishing of connection within sub-telephone system 15 described in the previous chapter. In this case mobile station 10 contacts mobile telephone 12, 13 through terminal device 40, node 70, repeater 81, ATM-switch 80, repeater 83, node 71 and terminal device 42, 43, as presented in Figure 2.

If the number of B-subscriber is not found in information packets 47 of network server 90, B-subscriber has not registered in the information system according to the invention. In this case network server 90 relays the call of A-subscriber to mobile communication switching center 100 through cable 120 (alternatively the call can be transferred to traditional telephone exchanges 110 and 130 over cables 121 and 122). Network server 90 also performs the required standard conversions prior known to a person skilled in the art, such as GSM -audio encoding and the decoding of GSM -audio coding into the coding standard used in mobile communication switching center 100, e.g. such as 64 kbps PCM -coding standard. If 64 kbps PCM -coding is used directly for audio encoding in mobile stations 10 to 13, no protocol conversions needs to be carried out. In this case telecommunication networks are loaded naturally approximately five times more, but in high capacity telecommunication networks this brings no problems. For mobile communication switching center 100 this kind of a connection is alike a call coming from fixed telephone network 110, 130, but if required, it is possible to transfer even signalings characteristic of GSM standard between mobile communication switching center 100 and mobile station 10. In this way e.g. it is possible to transfer the real subscriber

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identification (telephone number 56 and information field 57 read from intelligence card 34) to B-subscriber in the method defined by GSM-standard.

By using signaling according to GSM-standard like in base station controller 104, network server 90 is from the point of view of mobile communication switching center 100 like any base station controller 104. In this case mobile communication switching center 100 transfers messages with mobile stations 10 to 13 just as if they were connected to the mobile communication network by radio like traditional mobile station 14. From mobile communication switching center 100 a call to B-subscriber, e.g. mobile station 14, is transferred as prior known by a person skilled in the art. No changes are needed in mobile communication switching centers 100, base station controllers 104 and base stations 105. If B-subscriber is a customer of wired network, e.g. traditional telephone network 110 or ISDN-network 130, a call is routed through these networks as normal.

In the embodiment described above, 2 separate numbers are required - a GSM number and a LAN number and the server needs to keep a register to take care of the binding of these 2 numbers. However, in a preferred embodiment, the virtual BTS takes care of this binding, and the MUX of the mobile of the mobile station changes between GSM and LAN modes. This provides greater flexibility because the bindings are not determined inside the IP network, but are instead made between the virtual base station and the base station controller.

The above is a description of the realization of the invention and its embodiments utilizing examples. It is self evident to a person skilled in the art that the invention is not limited to the details of the above presented embodiments and that the invention can be realized also in other embodiments without deviating from the characteristics of the invention. The presented embodiments should be regarded as illustrating but not limiting. Thus the possibilities to realize and use the invention are limited only by the enclosed claims. Thus different embodiments of the invention specified by the claims, also equivalent embodiments, are included in the scope of the invention.

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For example, whilst the embodiments refer to intranet offices, it is not restricted to the intranet, but is also applicable to the internet.

Annex 1 comprises a technical overview of wireless internet telephony according to the present invention.

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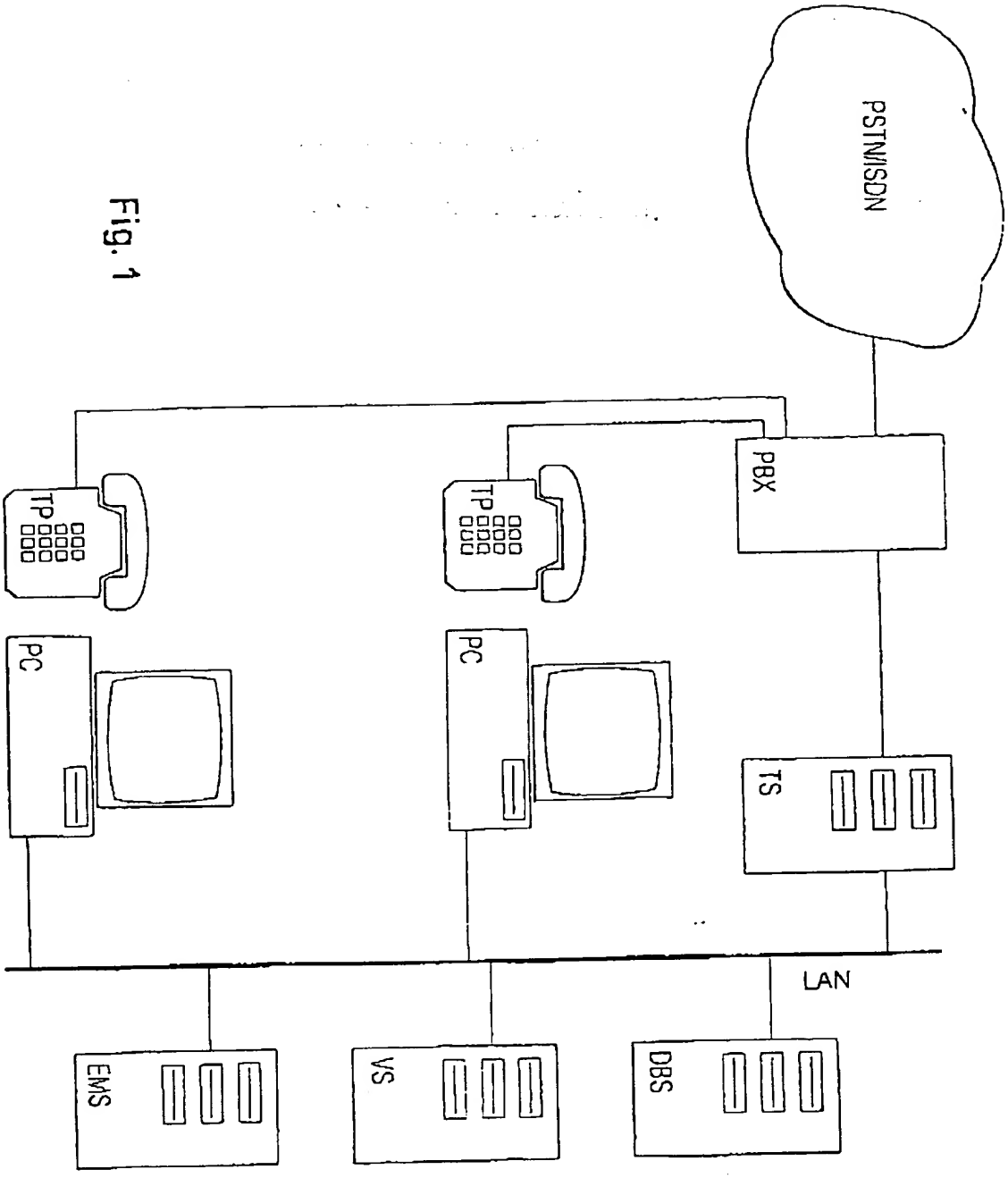

Fig. 1

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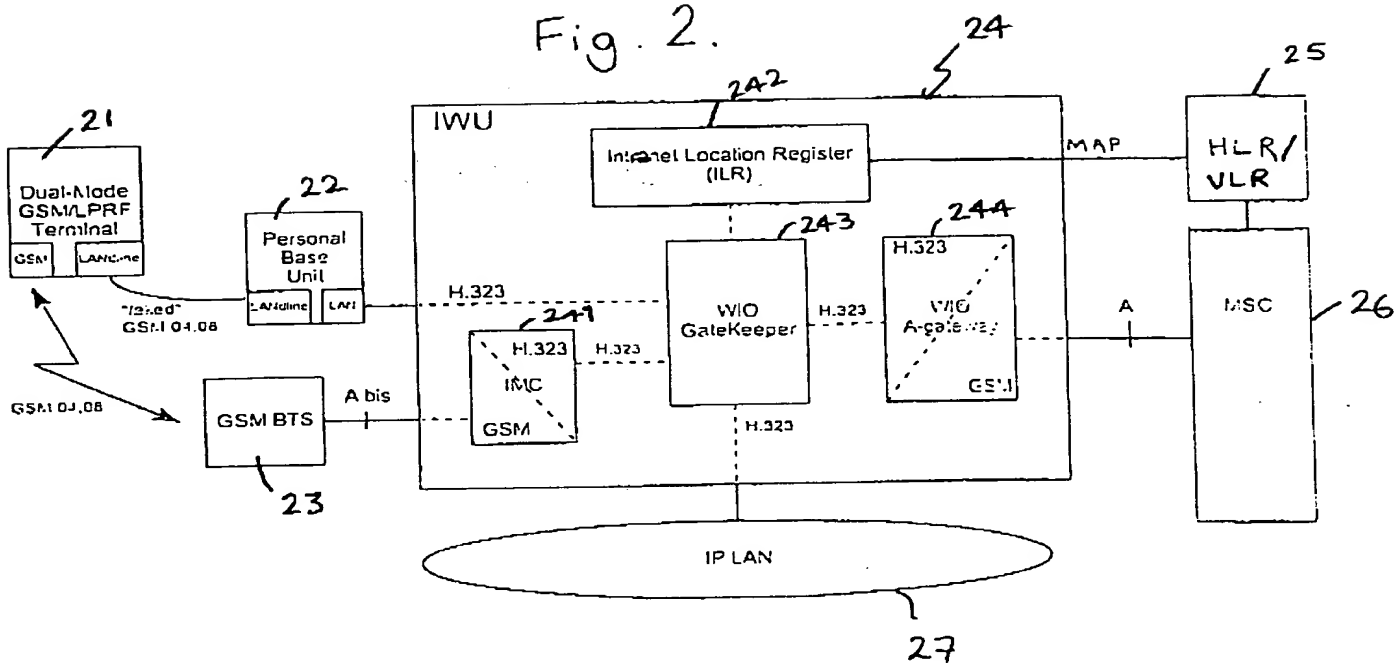
Fig. 2.



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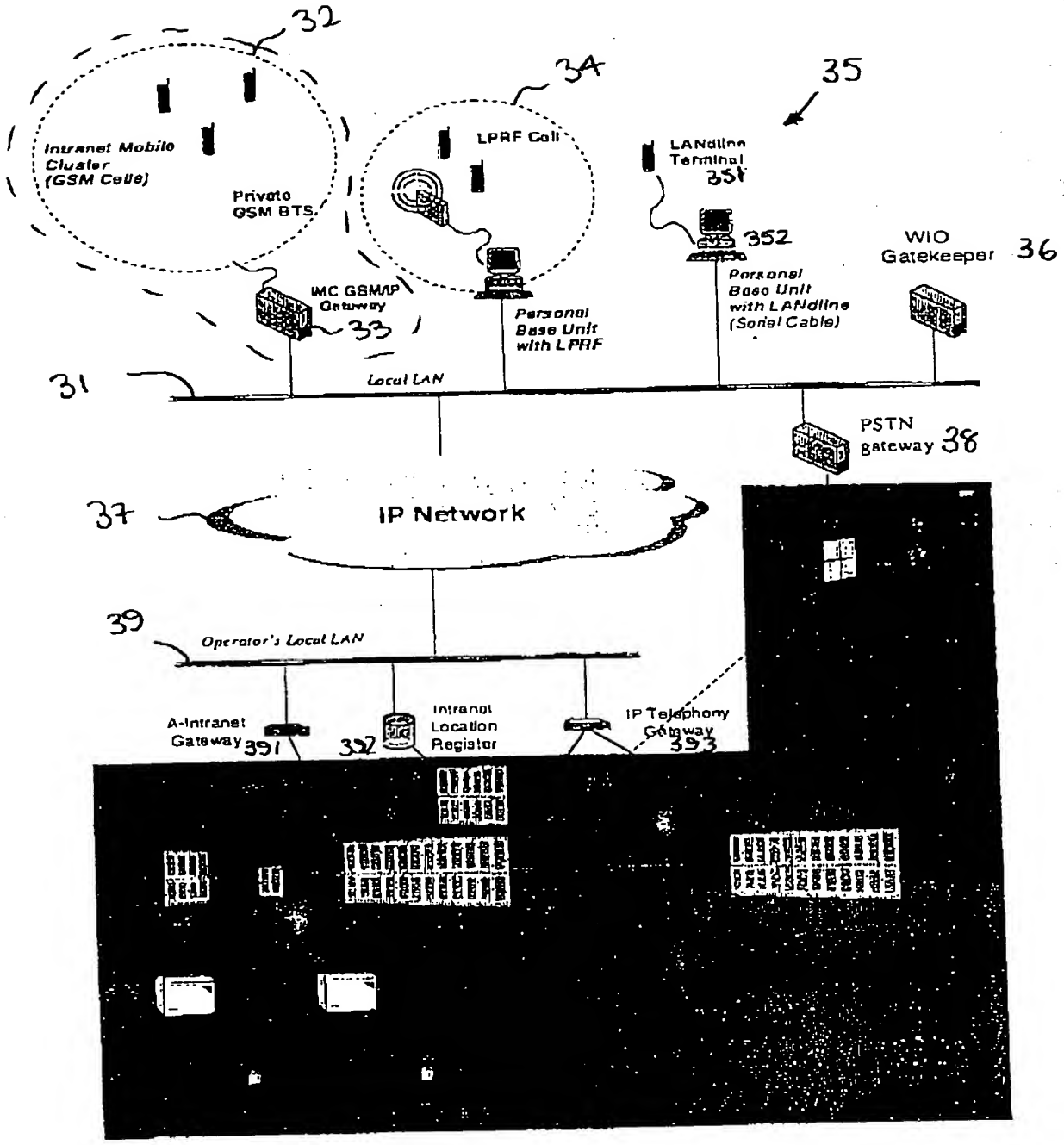

Fig. 3.

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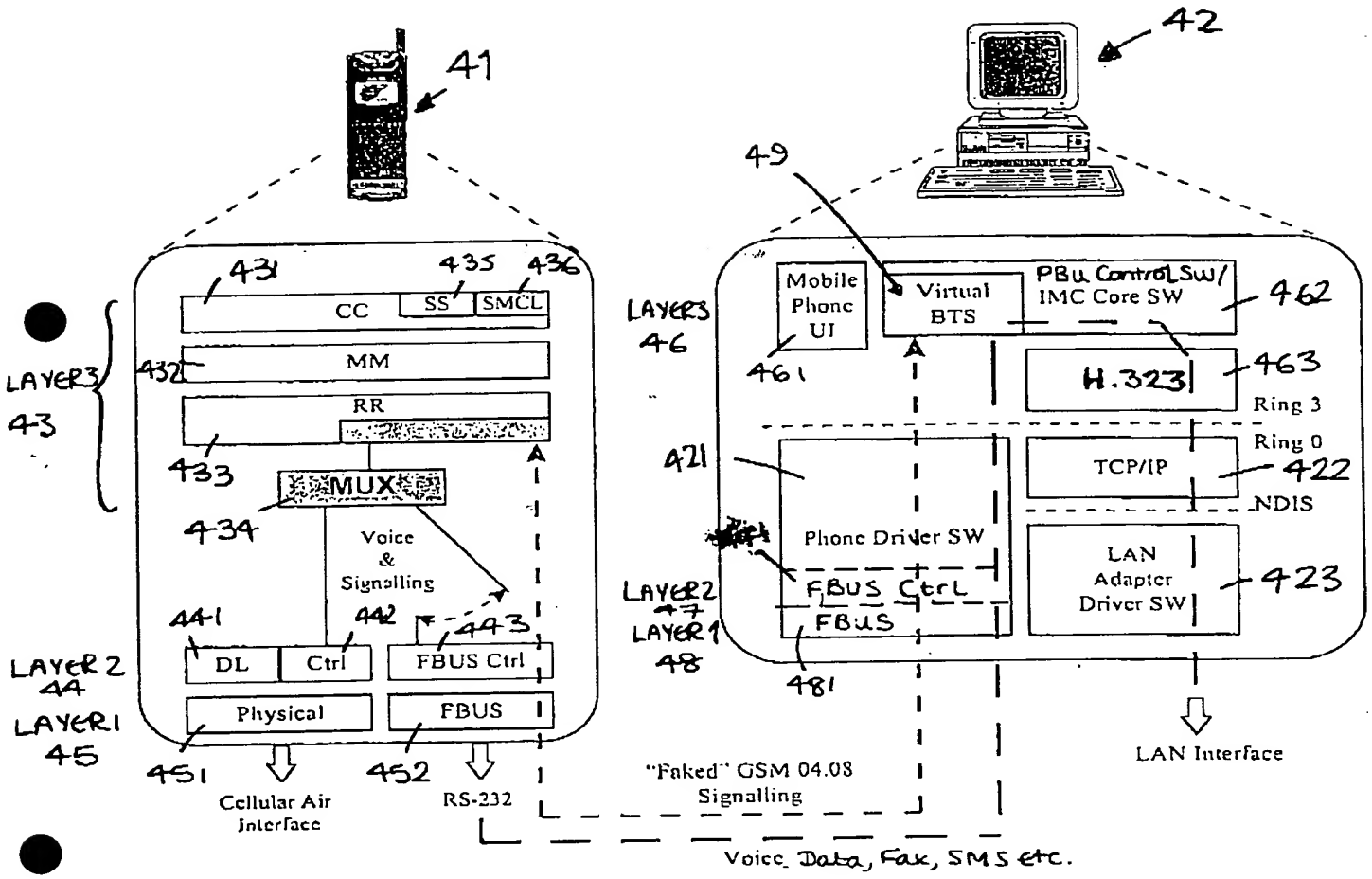

Fig. 4.

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3-MAR.'98(WED) 15:23 NMP PATENTS UK FAX:00 44 1276 677720 P.005

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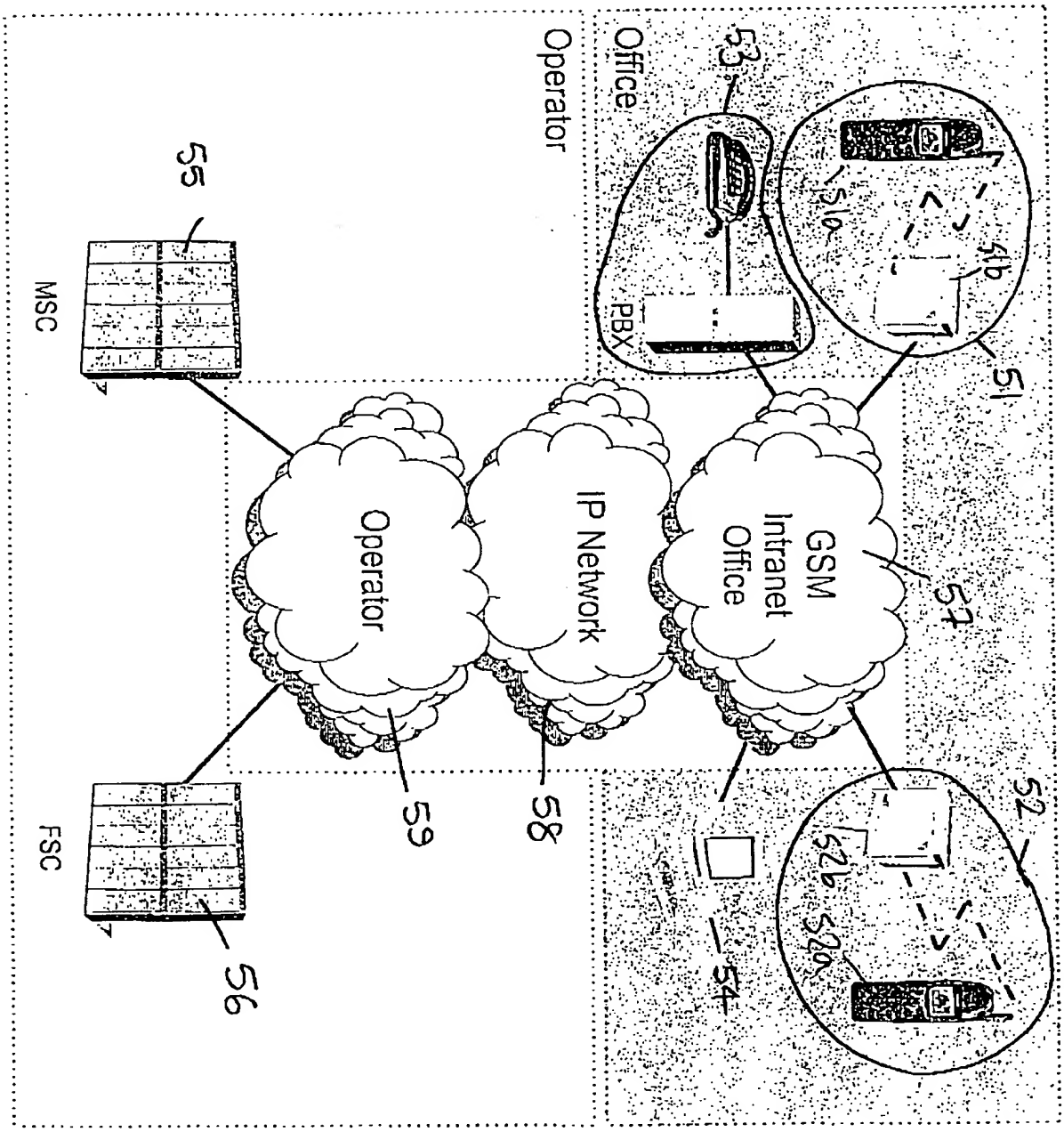
GSM Intranet Office
Operator
Office
PBX
MSC
FSC
GSM Intranet Office
IP Network
Operator
51
52
53
54
55
56
57
58
59
51a
51b
52a
52b

Fig. 5

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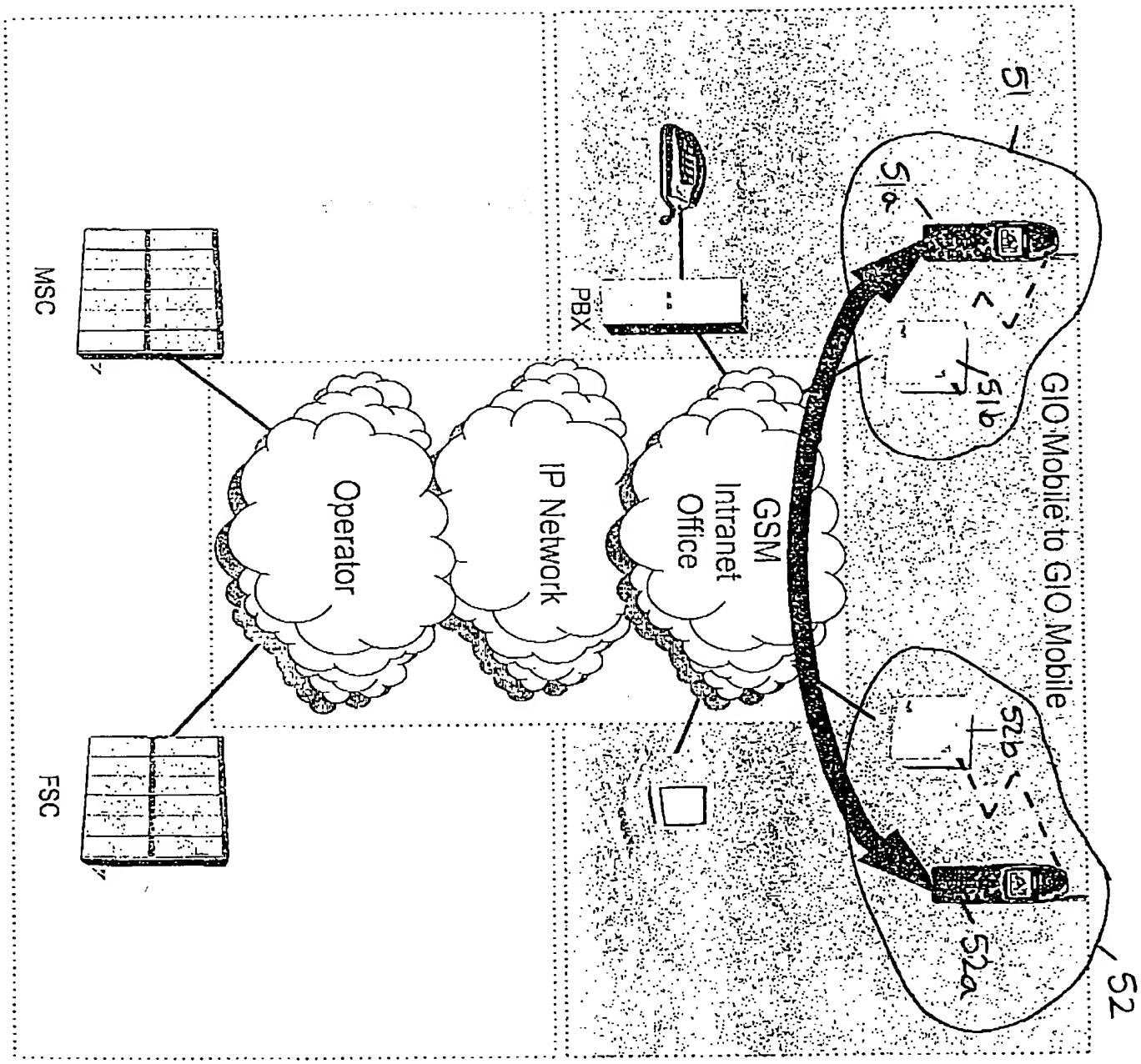
51
51a
51b
GIO Mobile to GIO Mobile
PBX
MSC
FSC
Operator
IP Network
GSM
Intranet
Office
52b
52a
52

Fig. 6

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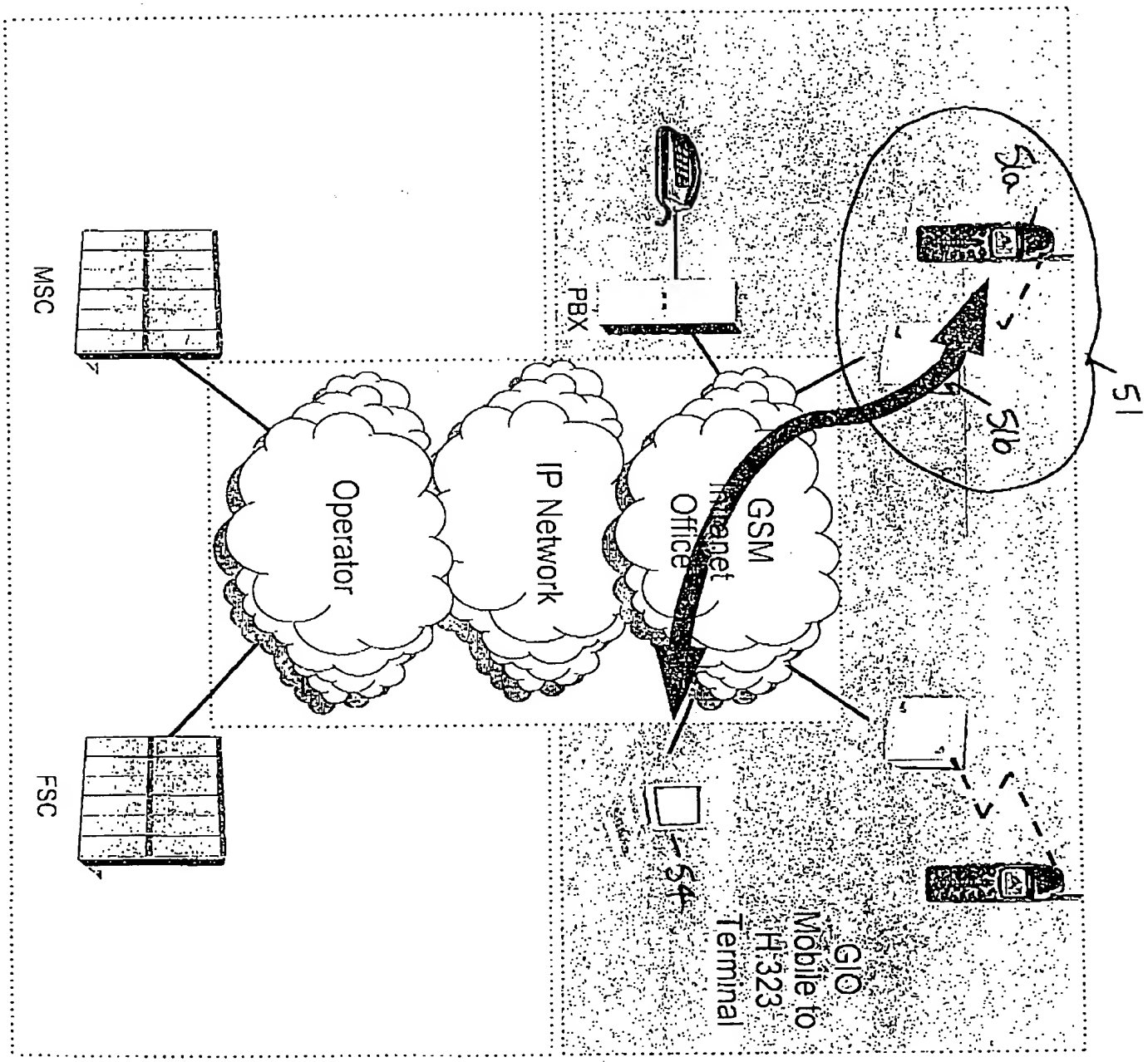
MSC
PBX
Operator
IP Network
GSM Internet Office
FSC
5a
5b
51
54
GIO Mobile to H.323 Terminal

Fig. 7

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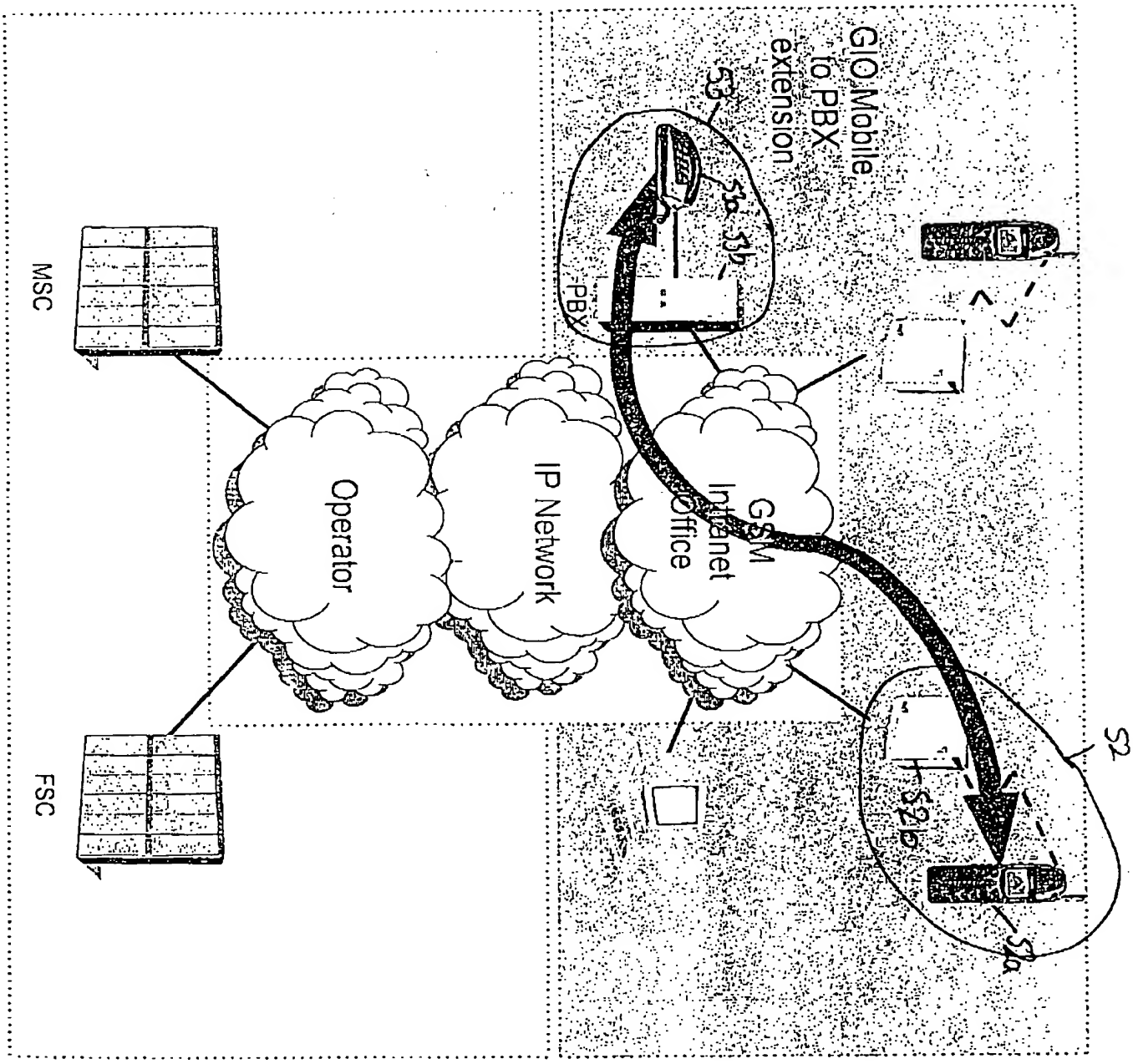
GlO Mobile to PBX extension
53
53a
53b
PBX
MSC
FSC
Operator
IP Network
GSM Intranet Office
52
52b
52a

Fig. 8.

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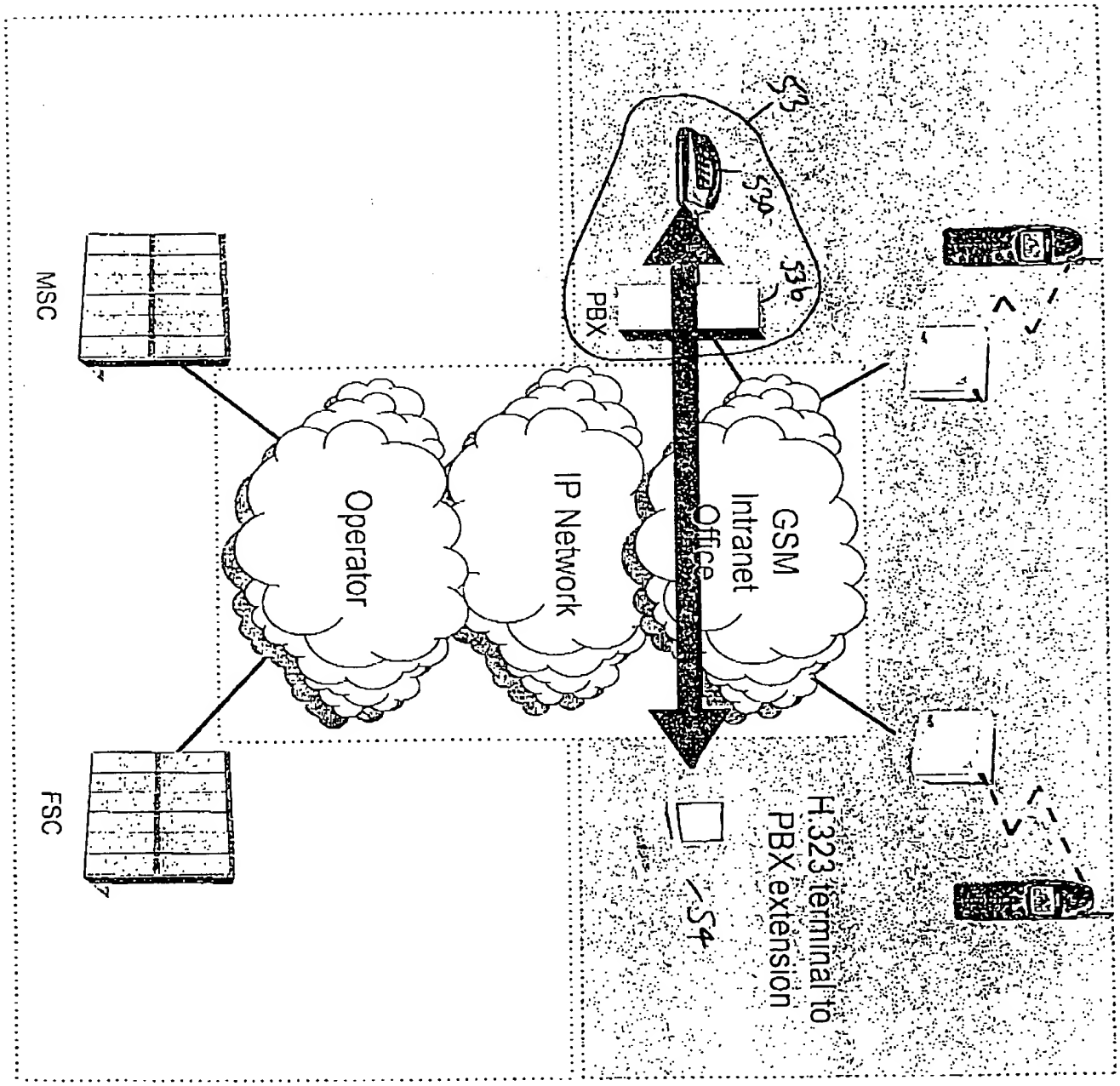
MSC
FSC
PBX
Operator
IP Network
GSM
Intranet
Office
H.323 terminal to
PBX extension
53
54
56

Fig. 9

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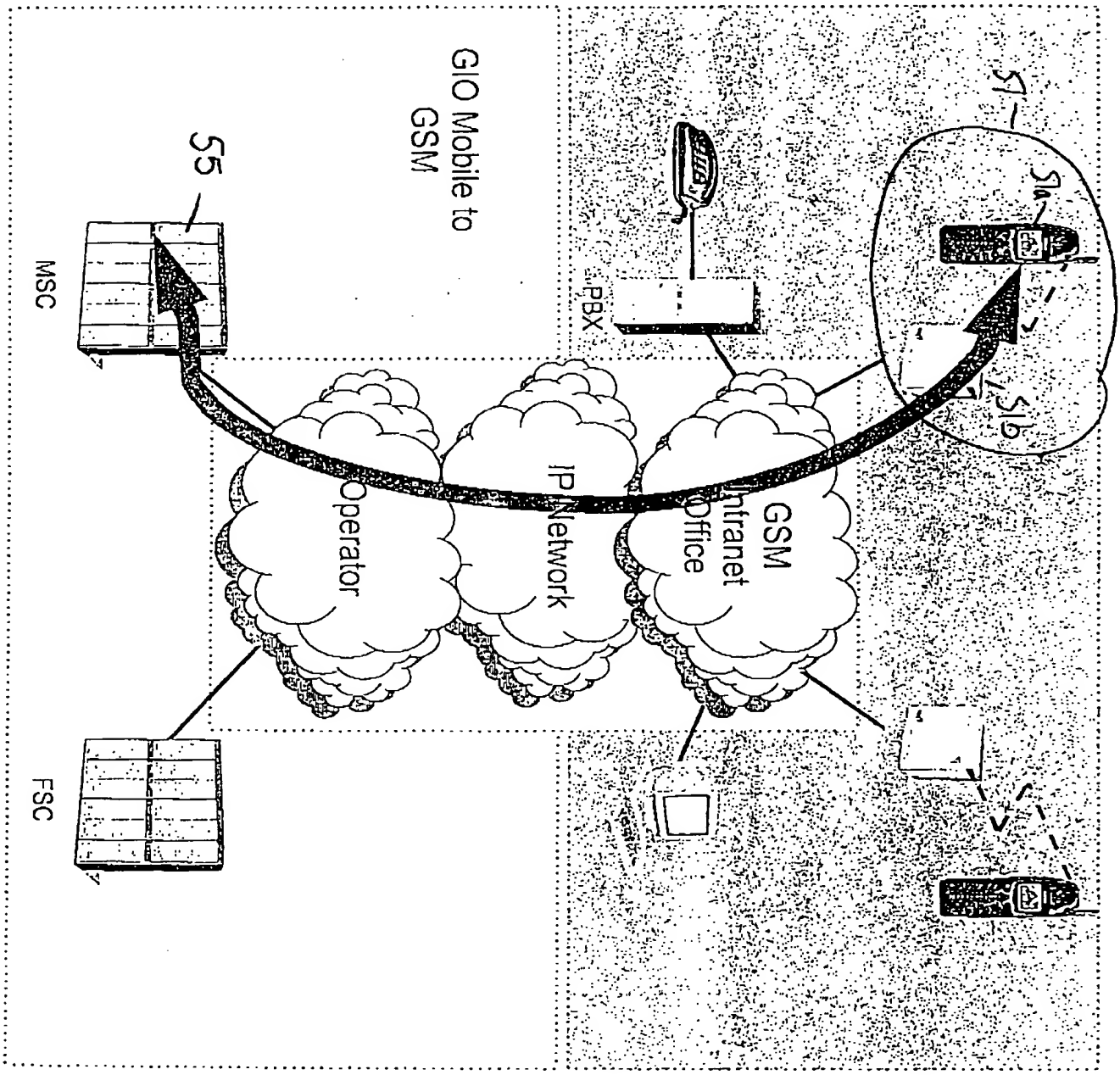
GIO Mobile to GSM
55
MSC
FSC
PBX
Operator
IP Network
GSM Intranet Office
57
51a
51b

Fig. 10

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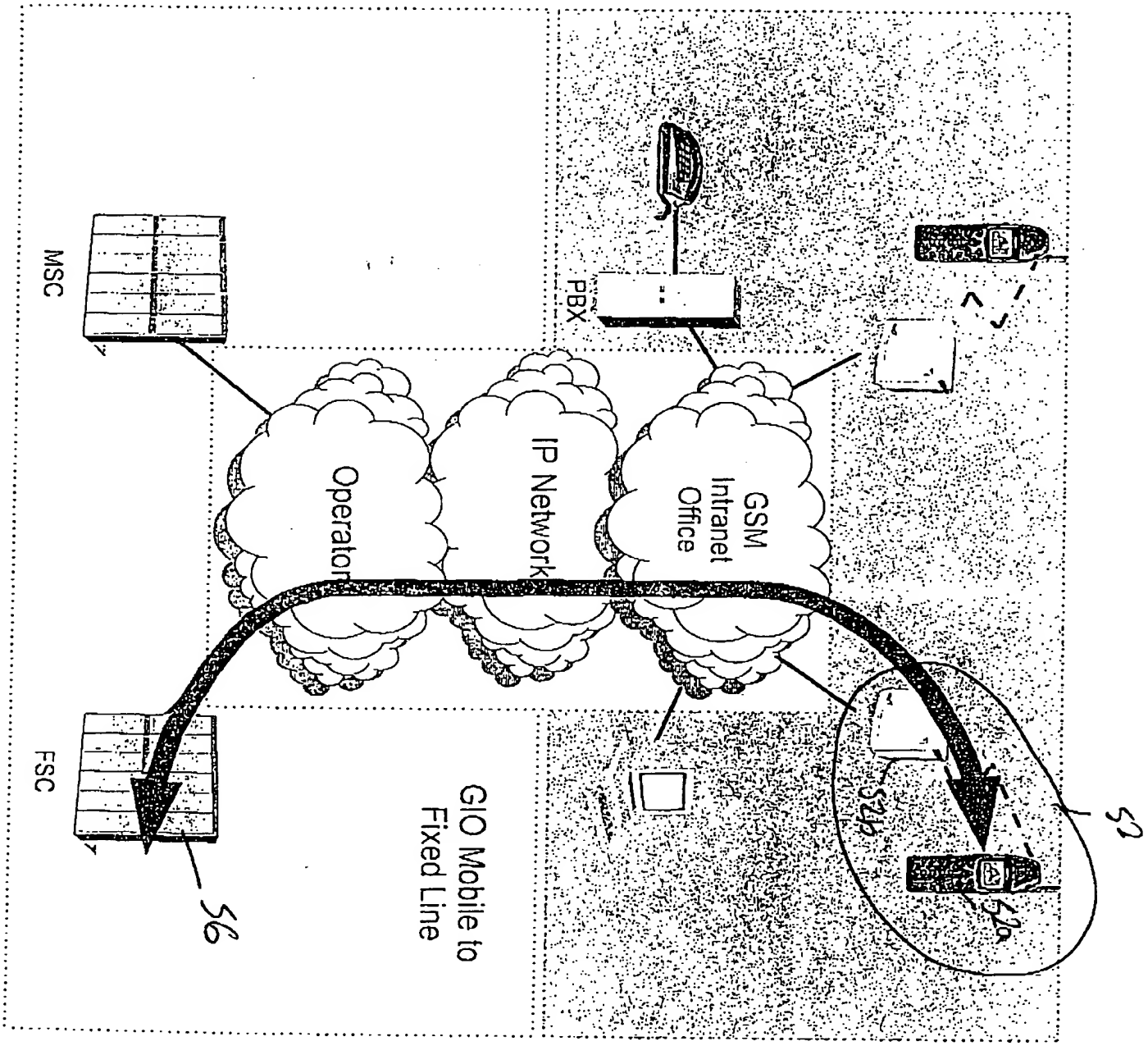
MSC
PBX
Operator
IP Network
GSM
Intranet
Office
FSC
GIO Mobile to
Fixed Line
56
52
52a
52b

Fig. 11

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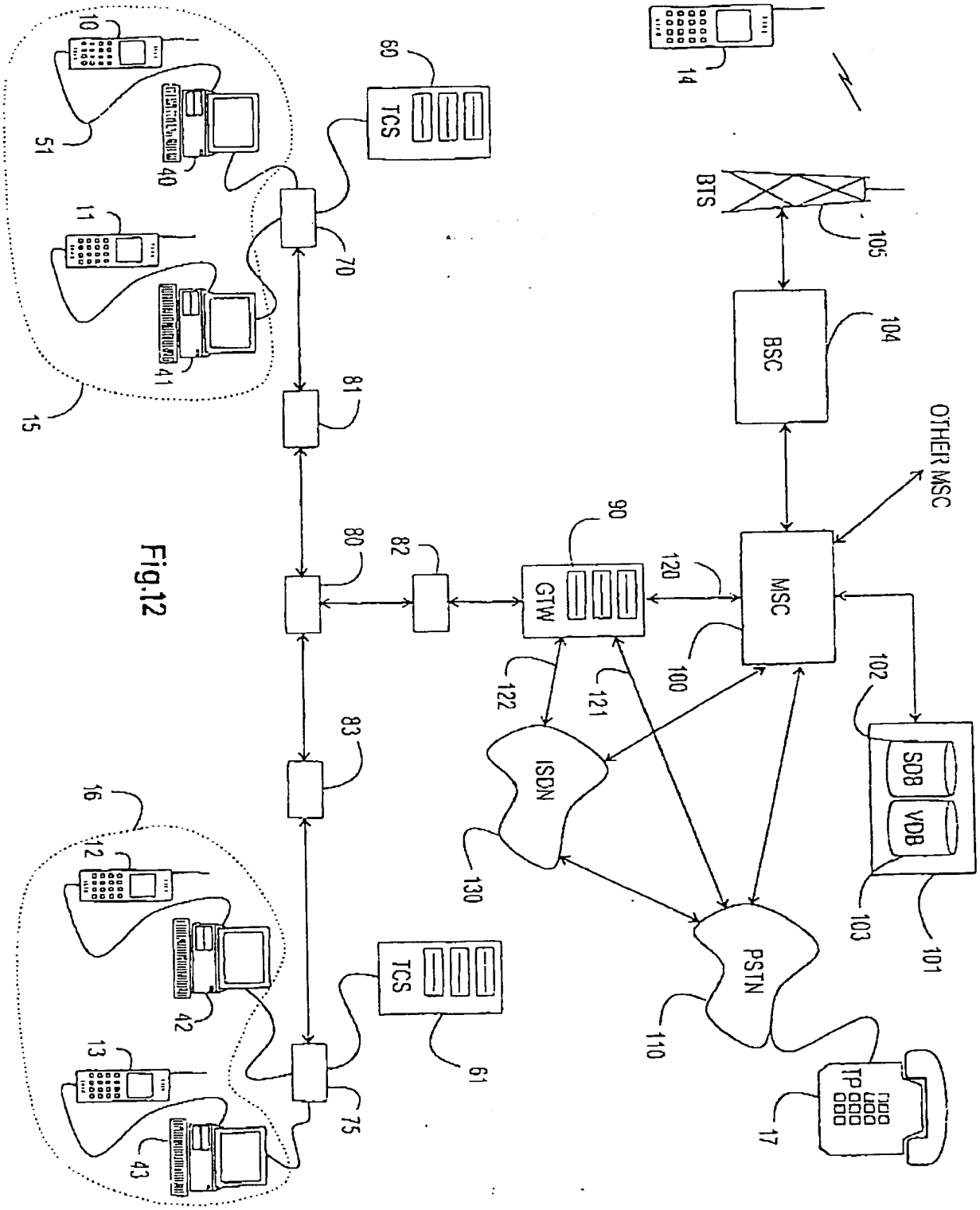
14
BTS
105
BSC
104
OTHER MSC
MSC
120
100
GTW
90
122
121
ISDN
130
SDB
VDB
102
103
101
PSTN
110
TP
17
TCS
61
75
16
12
42
13
43
80
82
83
81
70
TCS
60
10
51
40
11
41
15

Fig.12

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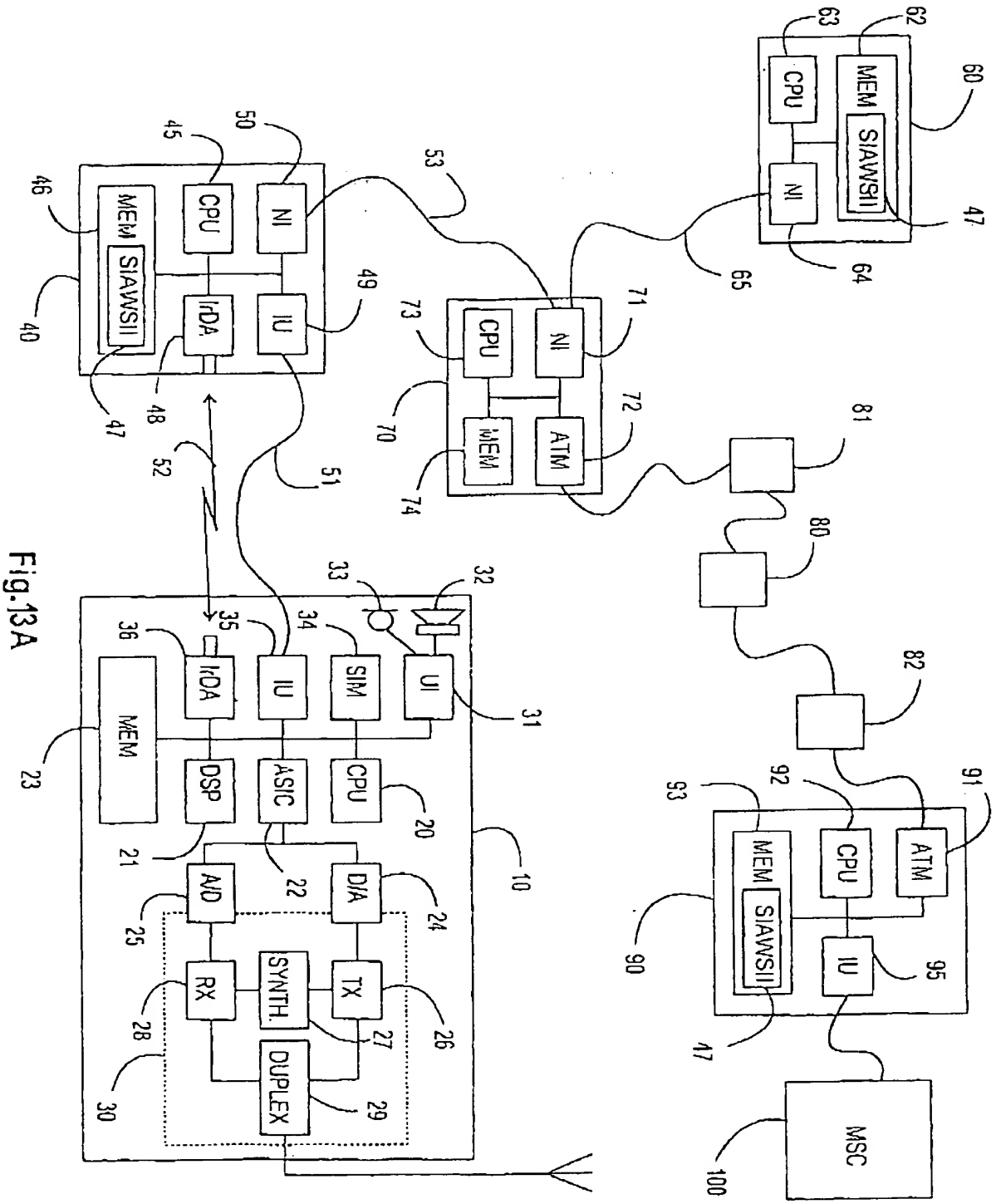
CPU
MEM
SIAWSII
NI
60
62
63
64
65
47
45
50
46
40
49
IrDA
IU
48
51
52
53
71
73
70
72
74
ATM
81
80
82
91
92
93
90
95
100
MSC
33
32
35
34
36
UI
SIM
31
23
DSP
ASIC
20
21
22
10
A/D
DIA
24
25
RX
SYNTH.
TX
26
27
28
29
30
DUPLEX

Fig.13A

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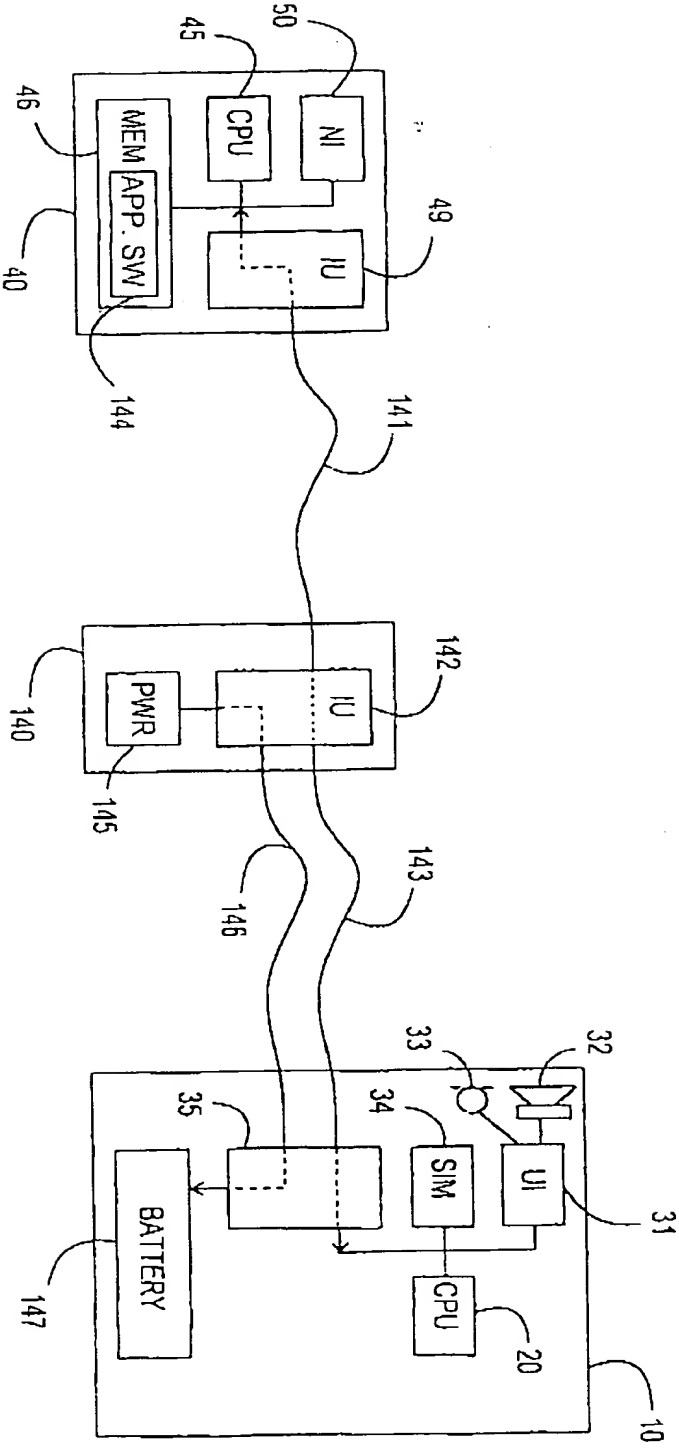
45
50
46
CPU
NI
MEM
APP. SW
IU
49
40
144
141
140
PWR
IU
142
145
146
143
33
32
35
34
SIM
UI
31
BATTERY
147
CPU
20
10

Fig.13B

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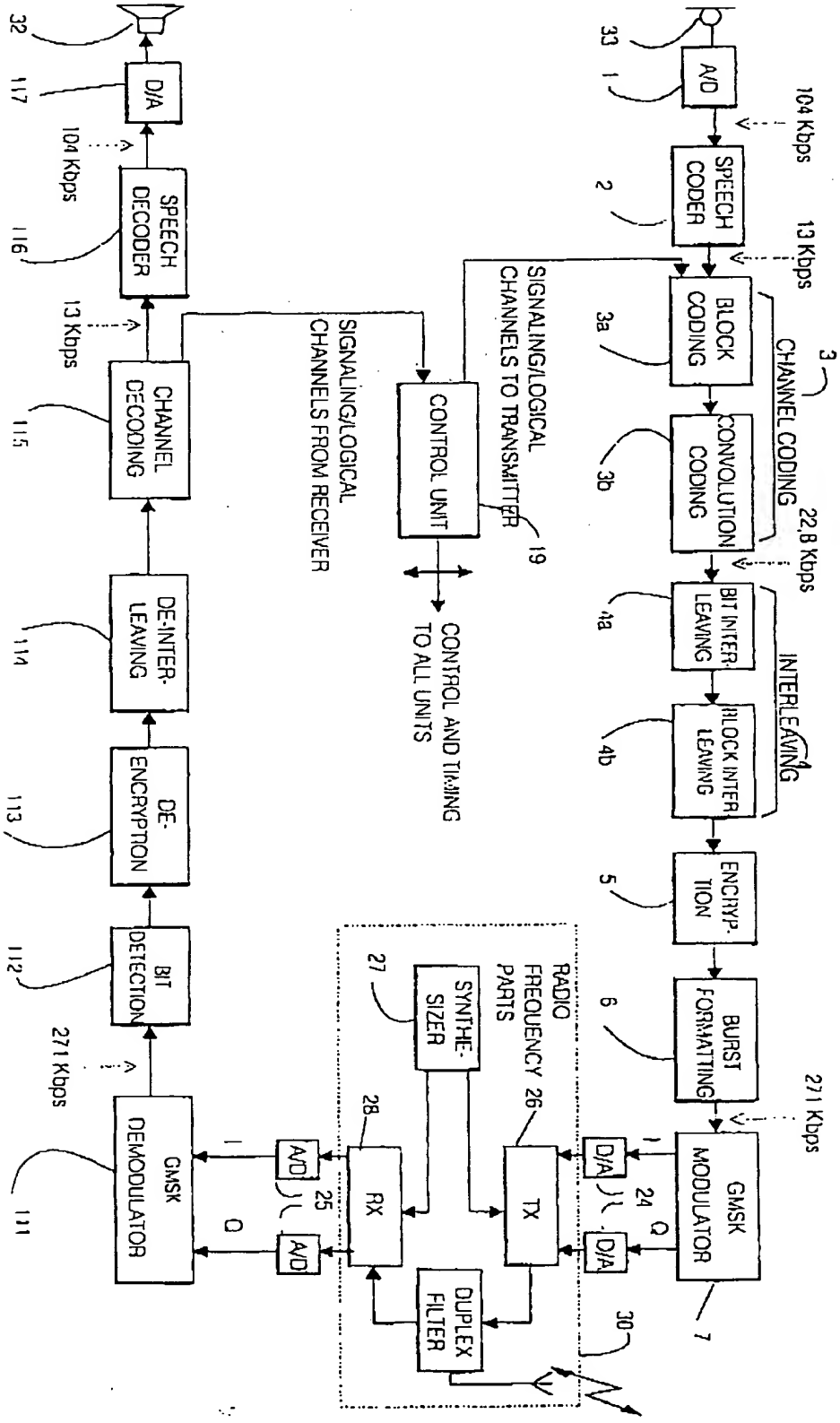
A/D
33
1
104 Kbps
SPEECH CODER
2
13 Kbps
BLOCK CODING
3a
CHANNEL CODING
3
CONVOLUTION CODING
3b
22.8 Kbps
BIT INTER-LEAVING
4a
BLOCK INTER LEAVING
4b
INTERLEAVING
ENCRYP-TION
5
BURST FORMATTING
6
271 Kbps
GMSK MODULATOR
7
D/A
24
I
Q
D/A
30
RADIO FREQUENCY PARTS
SYNTHE-SIZER
27
TX
26
RX
28
DUPLEX FILTER
A/D
25
I
Q
A/D
GMSK DEMODULATOR
111
271 Kbps
BIT DETECTION
112
DE-ENCRYPTION
113
DE-INTER-LEAVING
114
CHANNEL DECODING
115
13 Kbps
SPEECH DECODER
116
104 Kbps
D/A
117
32
CONTROL UNIT
19
SIGNALING/LOGICAL CHANNELS TO TRANSMITTER
SIGNALING/LOGICAL CHANNELS FROM RECEIVER
CONTROL AND TIMING TO ALL UNITS

Fig.14A

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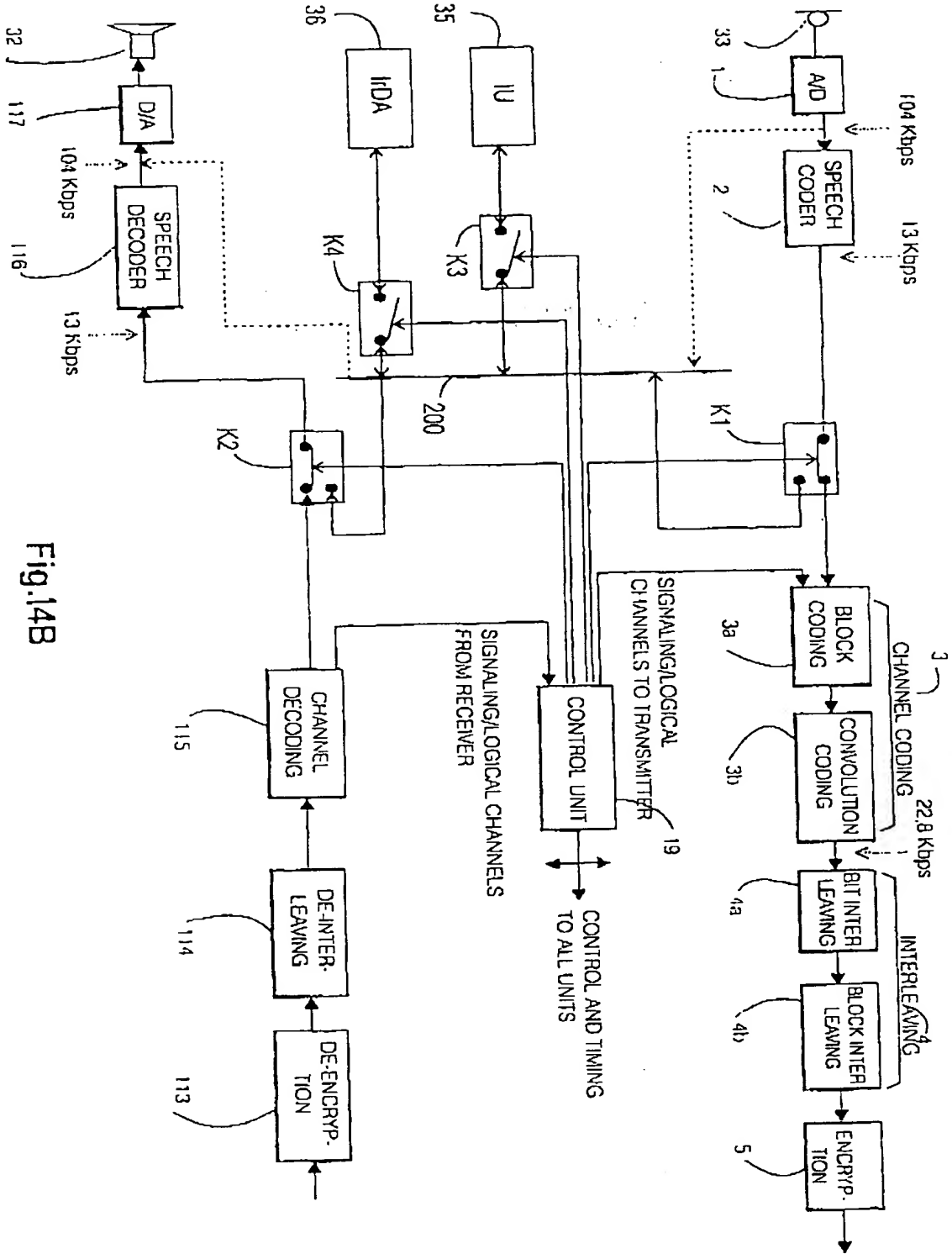
A/D
104 Kbps
SPEECH CODER
13 Kbps
IrDA
IU
K1
K2
K3
K4
200
BLOCK CODING
CONVOLUTION CODING
22.8 Kbps
BIT INTER LEAVING
BLOCK INTER LEAVING
INTERLEAVING
ENCRYP. TION
CHANNEL CODING
CONTROL UNIT
SIGNALING/LOGICAL CHANNELS TO TRANSMITTER
CONTROL AND TIMING TO ALL UNITS
SIGNALING/LOGICAL CHANNELS FROM RECEIVER
CHANNEL DECODING
DE-INTER. LEAVING
DE-ENCRYP. TION
SPEECH DECODER
D/A

Fig.14B

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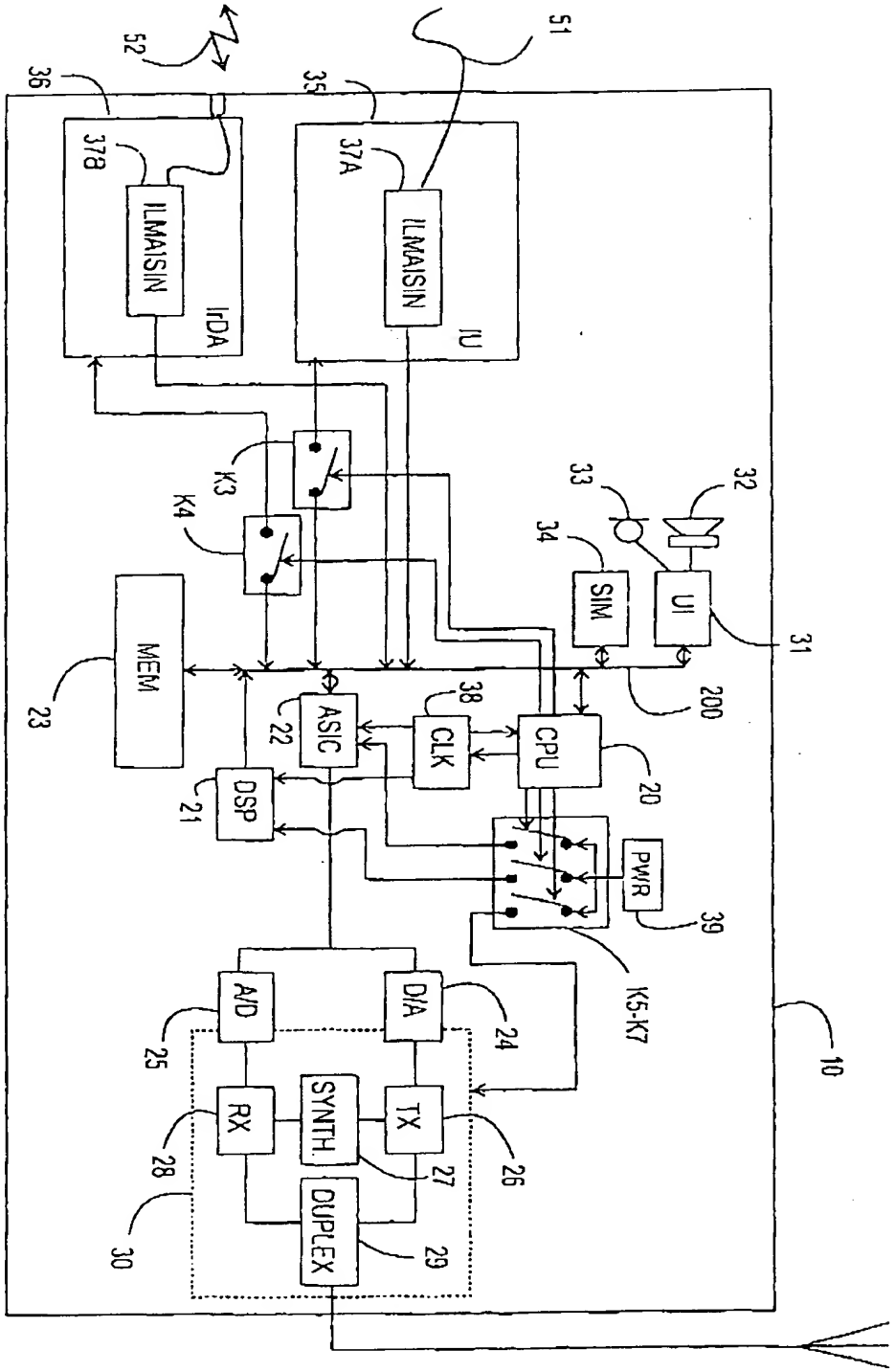
52
51
36
35
37B
37A
ILMAISIN
IrDA
ILMAISIN
IU
K3
K4
33
32
34
SIM
UI
31
MEM
23
ASIC
22
38
CLK
CPU
20
200
DSP
21
PWR
39
K5-K7
A/D
D/A
24
25
10
RX
SYNTH
TX
28
27
26
30
DUPLEX
29

Fig.15

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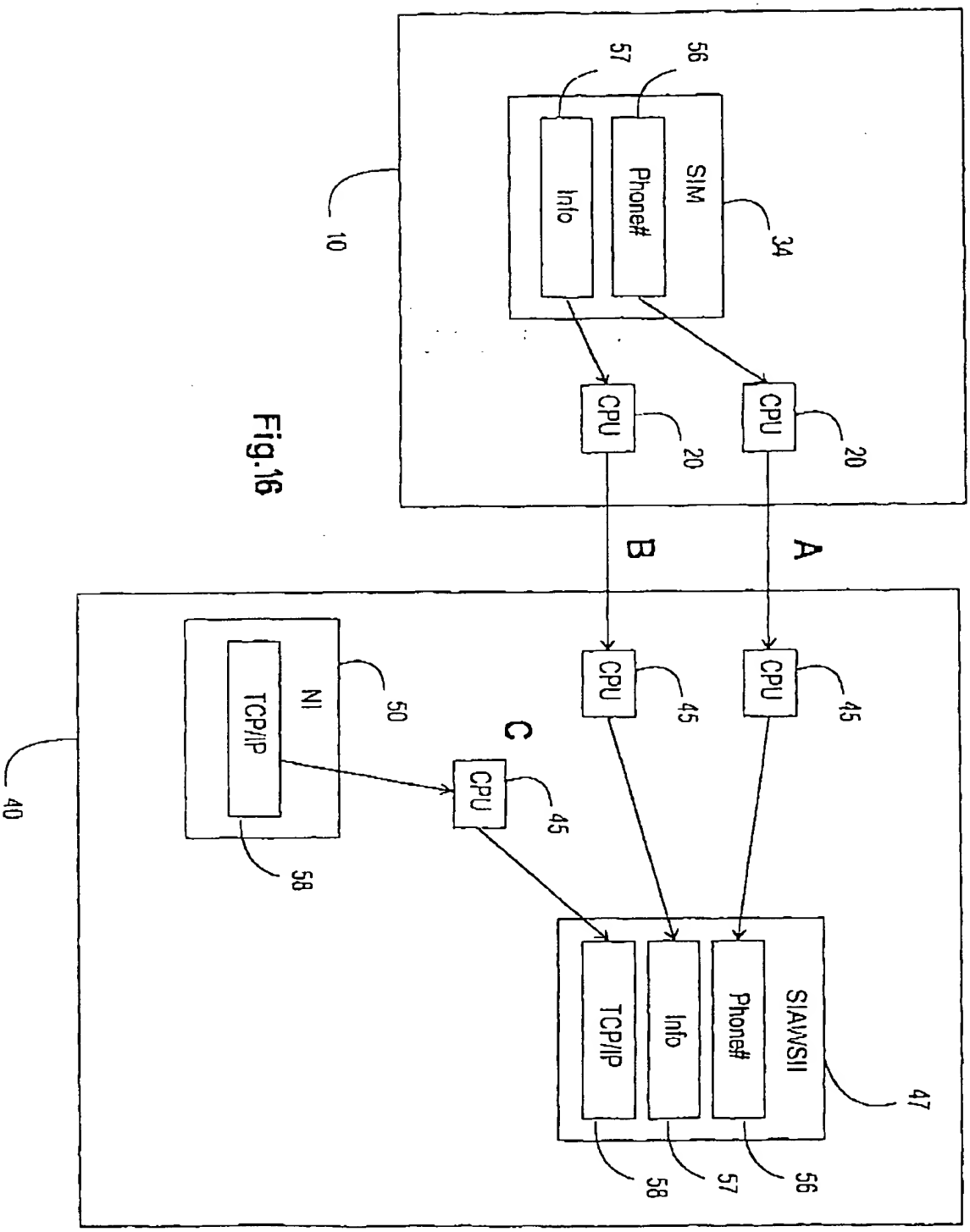
10
SIM
Info
Phone#
34
57
56
CPU
20
CPU
20
B
A
40
NI
TCP/IP
50
58
C
CPU
45
CPU
45
CPU
45
SIAWSII
TCP/IP
Info
Phone#
47
58
57
56

Fig.16

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ANNEX 1.

WIRELESS INTERNET TELEPHONY

TECHNICAL OVERVIEW

INTRODUCTION

The **Wireless Internet Telephony** concept integrates cellular telecommunication to customer's information system in a way that makes possible to locally offer cellular services with local extensions and evolving multimedia services to cellular end-users. LAN and the Intranet/Internet are used as a delivery network technology and these form a new kind of access network to cellular system network. All the communication between the backbone network and the end-user access node takes place via landline connection, i.e., via IP network(s).

The basic access interfaces are the air interface, the A-interface and the MAP interface. The A-interface is used as an access interface to mobile switching centre and the MAP interface is used as an access interface to HLR/VLR. The air interface can be any RF interface or infrared link, in principal, or it can be replaced with a physical connection. The air interface is hidden so that from the point of view of cellular system network this new access network is seen as a standard BSS entity.

New network entities are added between the access interface to modify/de-modify cellular signalling and for O&M purpose. System design principal is to in-build minimal set of cellular behaviour and to fully utilize open interfaces.

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Network architecture has been illustrated in *figure 1*.

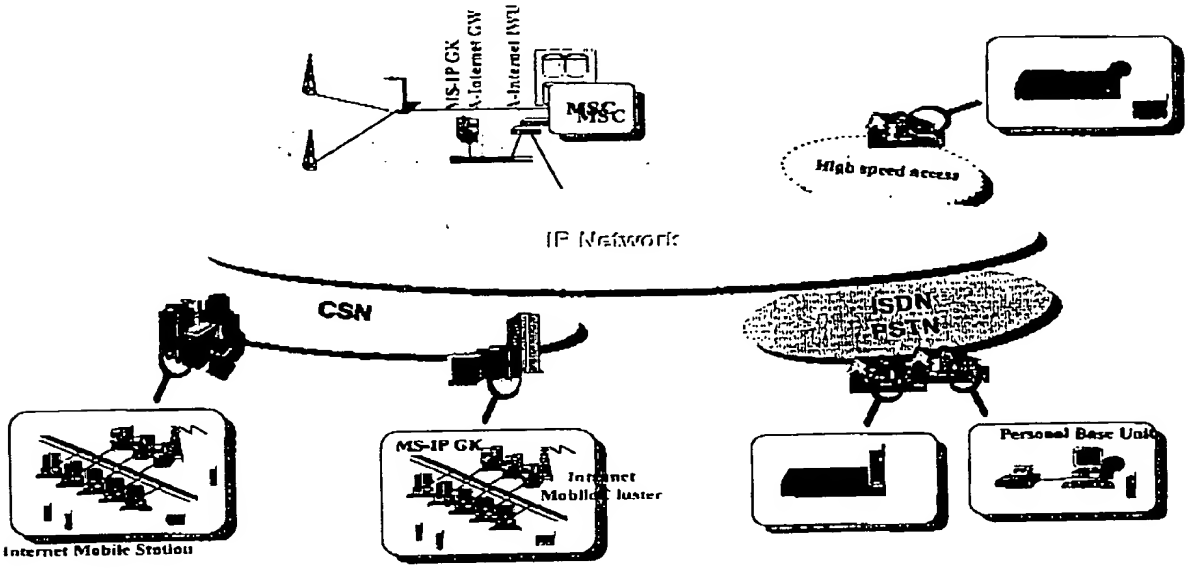

Figure 1. Network Architecture.

INTERNET MOBILE STATION

Internet Mobile Station (IMS) is a generic terminal product portfolio consisting of full-featured cellular phone which support services of GSM and GSM derivatives. It's working environments have been illustrated in *figure 2*. It will have specific features such as extended office/home cell selection criterias, and support of office and home area priority. With a serial cable and with a piece of software to a PC, network computer and set-top-box, Internet Mobile Station - so called LANdline version - enables seamless landline communication to cellular system network and between Internet Mobile Station users. In the second phase, it's a dual-band device enabling high value services within certain service areas.

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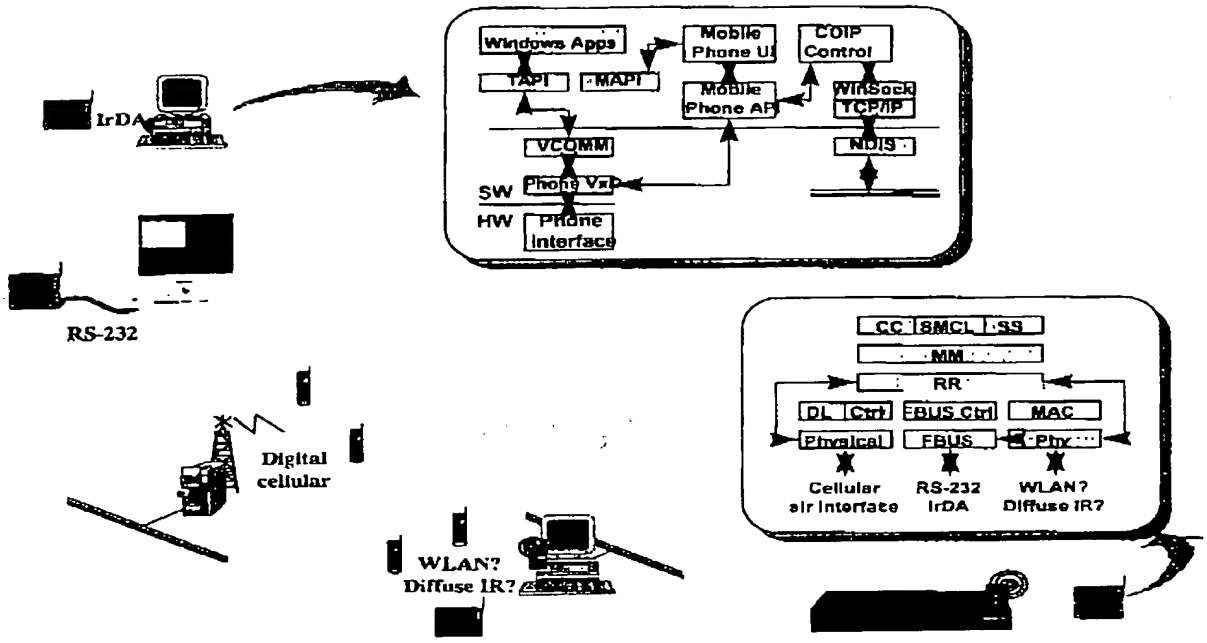

Figure 2. Working environments.

PERSONAL BASE UNIT

Personal Base Unit (PBU) is a radio card or an infra-red "plug-in" for a PC, network computer and set-top-box with a piece of software enabling wireless access to private or public IP network. It provides dual-band interoperability between cellular and unlisenced RF band or infra-red link. As a "base station" the Personal Base Unit can operate only on unlisensed mode, lower layers will be replaced with new ones, but signalling above them remains the same, i.e., cellular one.

INTRANET MOBILE CLUSTER

Intranet Mobile Cluster (IMC) is a BTS driver software package for a server on local LAN including rate adaptation and an O&M agent software package. The O&M agent communicates with the corresponding O&M entity in the operator site. Intranet Mobile Cluster provides interworking with data services and facsimile as a direct access to IP network.

LOCAL LAN

Local LAN is located physically at the office area and connected to the Internet.

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IP NETWORK

IP network is a global network carrying IP protocol. IP network is connecting Wireless Internet Telephony systems together and connecting these systems to the global cellular network and Public Switched Telephone Network (PSTN) trough the cellular network.

MANAGEMENT LAN

Management LAN is the LAN where the connections to the cellular network and management stations are. Management LAN is located physically in the operator or service provider premises.

MS-IP GATEKEEPER

MS-IP Gatekeeper (GKS) is a software package in a server on local and management LAN. MS-IP Gatekeeper provides user location tracking and local services such as local call switching service. Subscriber location is based on dynamic association of MSISDN, TMSI and network address. MS-IP Gatekeeper enables use of third party applications through open application programming interfaces (i.e., TAPI, for instance). It also keep statistics on the traffic for billing purposes. It's a software package for Windows NT including an O&M agent. MS-IP Gatekeeper can be a dedicated telecom server, or it's functionality can be integrated into Intranet Mobile Cluster and A-Internet Gateway.

A-INTERNET GATEWAY

A-Internet Gateway (GWS) is a software package in a server on management LAN. A-Internet Gateway makes the cellular and Internet location area associations. It has O&M software entity which operates as an administrative server gateway for corresponding agents in Intranet Mobile Clusters and MS-IP Gatekeepers. In addition, A-Internet Gateway may operate as a firewall between public telecommunication network and private Intranet solutions.

A-INTERNET IWU

A-Internet IWU (Interworking Unit) is a router which converts IP traffic to G.703 traffic. It may provides also speech transcoding capability.

INTERNET CELL CONFIGURATION

From the point of view of GSM system network, the Internet cells form multiple so called Internet location areas, each location area having a single or multiple Internet cells. Each Internet cell consists of one or several Internet Mobile Stations (Note! LANdline versions) or Personal Base Units, and one Intranet Mobile Cluster. Each Internet cell in managed by a local MS-IP Gatekeeper. Each Internet location area is managed by a master MS-IP Gatekeeper, and A-Internet Gateway makes the mapping between Internet location areas and conventional cellular ones. Internet cell configuration has been illustrated in *figure 3*.

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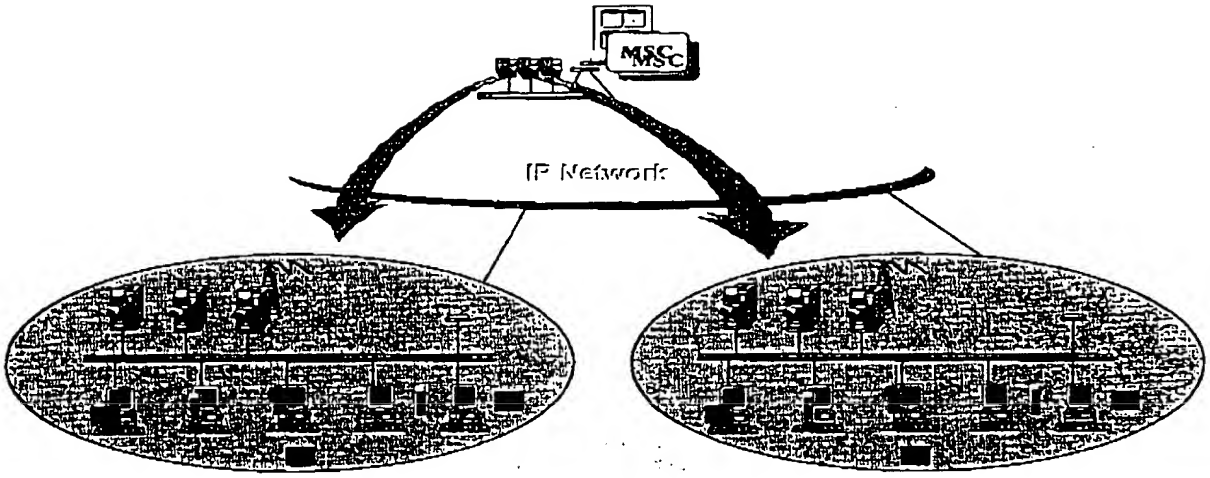

Figure 3. Internet cell configuration.

The Internet site location areas contain one or several virtual BSCs and BTSs. Definition of BSCs and BTSs is needed for compatibility reasons to cellular system network configuration.

For each Internet cell certain necessary system parameters like Cell Identity (CI), and Base Station Identity Code (BSIC) must be defined. Discontinuous transmission (DTX) shall be used.

NETWORK TOPOLOGY

An Internet location area may include multiple LAN segments connected using routers or other devices, *figure 4*.

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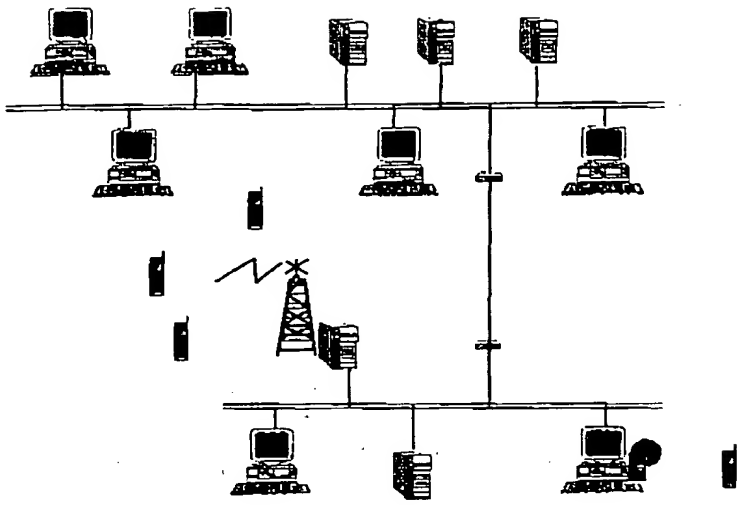

Figure 4. Internet location area.

Local MS-IP Gatekeepers form a virtual Gatekeeper network which is managed by a master MS-IP Gatekeeper, *figure 5*.

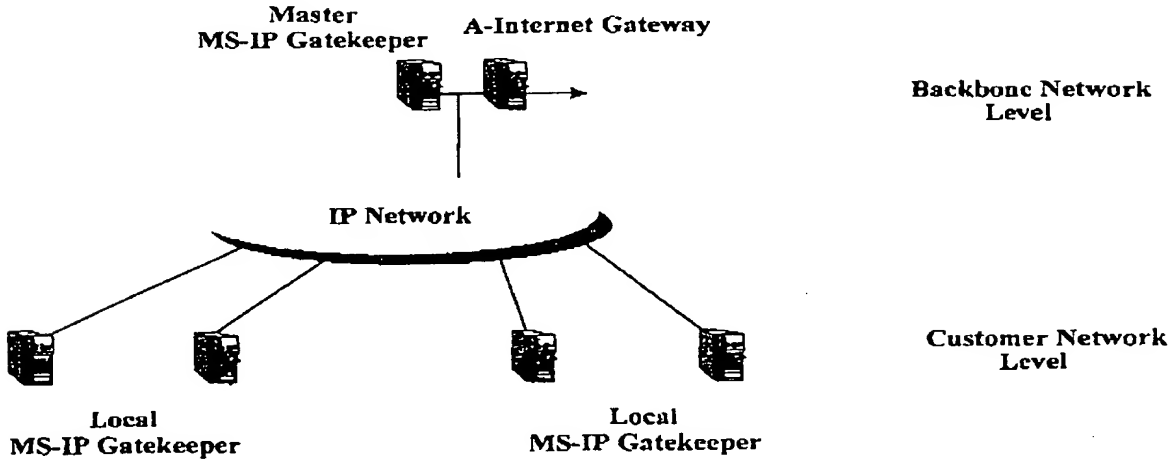

Figure 5. Gatekeeper network.

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GENERAL DESCRIPTION

Signalling is implemented according to GSM 04.08 recommendation with modified layer 1 and 2 by using TCP/IP protocol. Traffic, i.e., speech and short messages, is transferred through IP network using UDP/IP protocol. Facsimile and data services are implemented as a direct LAN access in case of Intranet Mobile Cluster and Personal Base Unit. Network addresses and port numbers of source and destination connection point is negotiated when signalling the call set-up.

All the network entities have a configuration file containing static and dynamic information about network topology, cellular system spesific information, internal security and authentication keys, etc., which is used for proper self-tuning during installation and power-up.

When powered up, the network entities make registration to upper hierarchy level, e.g., IMSes and IMCs register themselves to a local GKS, local GKSes to a master GKS, master GKSes to a GWS, and GWSes to an MSC.

Any network entity can be added or removed from the system anytime.

LANDLINE MODE

In this context, only LANdline mode of operation has been described.

The Internet Mobile Station entity can be installed anytime. The Internet MS entity in a PC, i.e., in a host PC, activates itself when a mobile station is connected to the PC.

When a mobile station is connected to a host PC, it enters the LANdline mode.

When the Internet MS entity notice that a mobile station has been connected, it generates registration to the Gatekeeper. Registration is based on static or dynamic method. In static method, the network address of the GK is known based on the previous registrations. In dynamic method, the registration is based on broadcasting. The host PC broadcasts the Registration Request message. The message contains the network address of the node and the type identification (i.e., "Internet Mobile Station"). The GKs which receive the message response with a Registration Confirmation message indicating that they can accpet the registration. The Internet MS selects one of the GKs by sending the Registration Confirmation message back to the selected GK.

A GK can also reject registration attempt by sending a Registration Reject message to the Internet MS. If there's no GKs available, the mobile station leaves the LANdline mode.

Registration is perfomed also periodically.

When the Internet MS has confirmed the registration the GK sends the System Information messages Type 2, 3 and 4 to the Internet MS. The Internet MS entity in host PC routes the

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messages to the mobile station. Based on the information of the messages the mobile station performs the location update procedure.

PLMN SELECTION AND ROAMING

PLMN Selection

After receiving the system information the mobile station starts to camp on the Internet cell site. The mobile station has three tasks: PLMN selection, cell selection, and location updating.

The mobile station camps on the Internet cell normally. The Internet cell is a cell of the selected PLMN, it's not barred, the LA is not in the list of forbidden LAs for national roaming, and the simulated radio path loss between the mobile station and the host PC is below a threshold set by the operator. The radio path loss criteria (C1) determines allways that communication is possible on that cell. The additional cell reselection parameters are ignored, so there is no cell reselection optimization.

The Internet cell is allways a high priority cell. The "received signal strength" on that cell is kept in maximum.

Internet Roaming

Roaming to the Internet location area is based on standard location update procedure. The location update procedure within the mobile station is "switched on" with the System Information messages sent by the host PC.

The mobile station sends a Location Update Request message to the Internet MS entity of the host PC which forwards the message to the MS-IP Gatekeeper. The message contains the mobile identity element, which is normally either TMSI or IMSI.

The GK forwards the message to the master GK. It's assumed that we have two level hierarchy in GK network. The message is forwarded to the A-Internet Gateway, which forwards the original message to the MSC as a standard location update request message. The Gatekeepers associate the terminal's network address with the mobile identity element (i.e., TMSI) of the mobile subscriber. When the network receives the location update request message, it's assumed that the network initiates the authentication procedure, allocates a new TMSI, and accepts the location update.

The network activates the authentication by sending an Authentication Request message to the mobile subscriber. The message is routed to the mobile station through the same route as the location update request message was routed from the mobile station to the network. The mobile station calculates and stores the new ciphering key and sends the Authentication Response message back to the network.

Before a new TMSI is allocated, ciphering must be activated by the network. The network sends a Cipher Mode Command to the mobile station, which activates the desired mode and the desired algorithm in the mobile station. The mobile station sends a cipher mode complete message

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to the network as a response to the cipher mode activation. In LANdline mode, ciphering is not in use.

After ciphering de-activation, the network sends a Location Updating Accept message to the mobile station with a new TMSI. Before the gateway forwards the message to the gatekeepers it adds the MSISDN of the mobile subscriber to the message. The gatekeepers confirm the network address association by replacing the TMSI with the MSISDN of the mobile subscriber in the network address association. After receiving the accept message the mobile station responses with a TMSI reallocation complete message. The network release the connection by sending a clear command message to the gateway, which forwards the message to the gatekeepers. The gatekeeper at customer premises level forwards the message to the mobile station.

Roaming to the Internet location area is illustrated in the *figure 6*.

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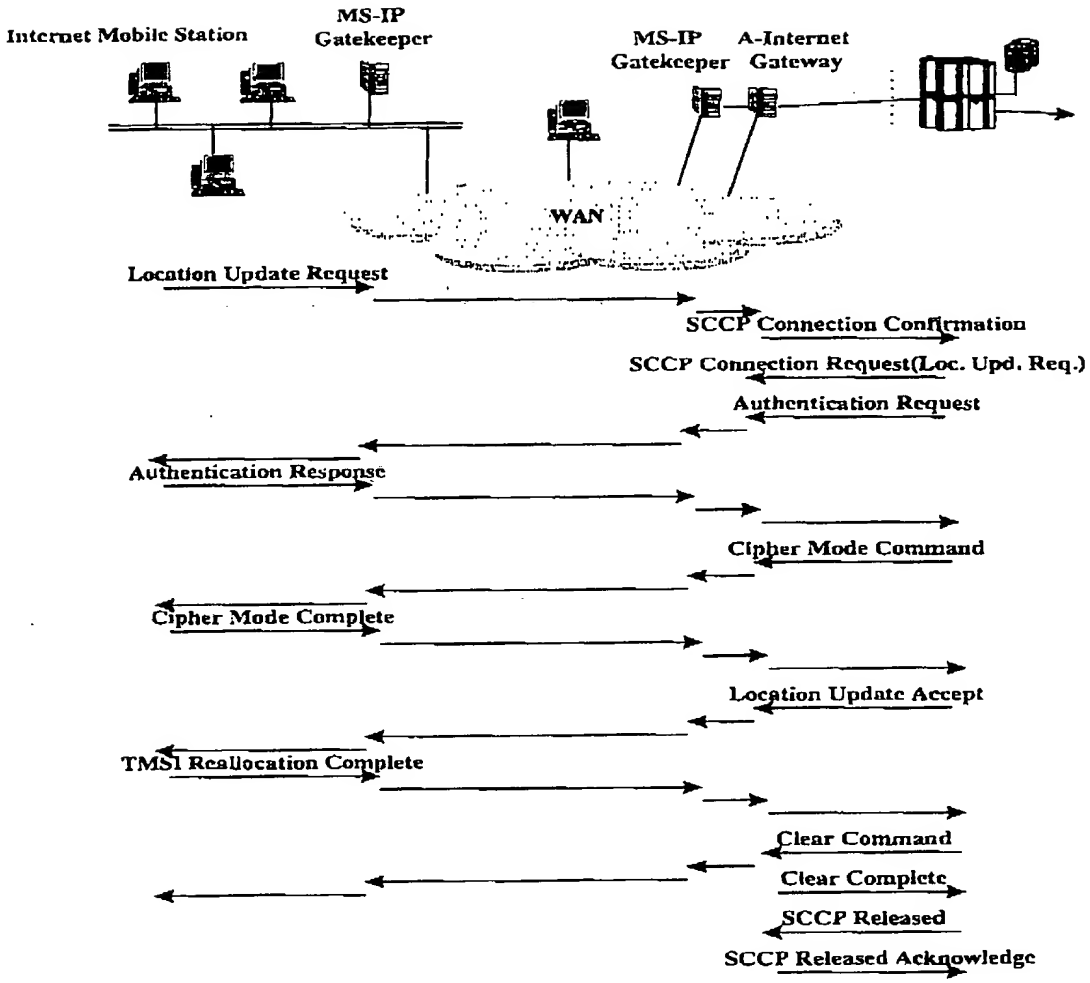

Figure 6. Roaming to Internet location area.

Periodic location update and IMSI attach/detach is supported.

Roaming to public network

Disconnection between the mobile station and the host PC is seen as a downlink signalling failure "on the air interface". In this case, a cell reselection procedure will be performed by the mobile station in order to select a new public network cell.

When the Internet MS entity notice that a mobile station has been disconnected, it generates de-registration to the Gatekeeper. The MS entity sends a Registration Cancel message to the GK. The message contains the MSISDN, the network address of the node and the type identification

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(i.e., "Internet Mobile Station"). The GK removes the network address association and forwards the message to the master GK. The master GK updates the de-registration and forwards the message to the GK network.

RADIO LINK SIMULATION

Channel Configuration

The messages on different logical channels are transmitted as such between the mobile station and the host PC.

Handover, RF Power Control

In the LANdline mode, the handover and the RF power control is not supported.

Radio Link Failure

The radio link failure control can be supported. In this case, the criterias from GSM 05.08 (i.e., radio link counter S based on decoding of SACCH messages) must be fullfilled and the RADIO LINK TIMEOUT parameter must be transmitted on the Internet BCCH.

Idle Mode Tasks

The discontinuous reception (DRX) is supported.

Downlink signalling failure is declared when the mobile station is disconnected from the host PC.

Monitoring of BCCH carriers as indicated by the BCCH allocation is performed (GSM 05.08). Measurement of the serving cell (i.e., Internet cell) is ignored.

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CALL SERVICES

In this context, only LANdline mode of operation has been described.

LOCAL CALL

Local call means a call which doesn't use A-Internet Gateway. In local call, authentication, ciphering activation, TMSI re-allocation, and identification enquiry is not performed.

The connection set-up model is used where the call signalling is routed via the Gatekeeper to the mobile station. Communication on "traffic channel" takes place directly from host PC to host PC. The Internet mobile stations can support audio transmission only. The audio coding is GSM 06.10 audio. Coding is performed by the mobile station or by the host PC depending on the user application.

The A-subscriber's mobile station sends a CM Service Request message indicating the requested type of transaction, which is mobile originating call establishment in this case. The Gatekeeper sends a CM Service Accept message back to the mobile station indicating that the call establishment attempt is accepted. After receiving the message the A-subscriber mobile station sends a call Set-up message to the Gatekeeper. The message contains the network address of the A-subscriber and the MSISDN of the B-subscriber. The Gatekeeper uses the message to define whether a local call, an Internet, or an external call establishment attempt has been initiated. It forwards the message to the network address of the B-subscriber, and sends a Call Proceeding message to the A-subscriber. The host PC of the B-subscriber forwards the call Set-up message to the B-subscriber mobile station. The mobile station accepts the call set-up by sending a Call Confirmed message to the Gatekeeper. The B-subscriber mobile station sends an Alerting message to the Gatekeeper which forwards the message to the A-subscriber. After that the B-subscriber mobile station sends a Connect message to the Gatekeeper, which is also forwarded to the A-subscriber. The message contains the network address of the B-subscriber. The A-subscriber responses by sending a Connect Ack message to the Gatekeeper.

The local call flow chart has been illustrated in *figure 7*.

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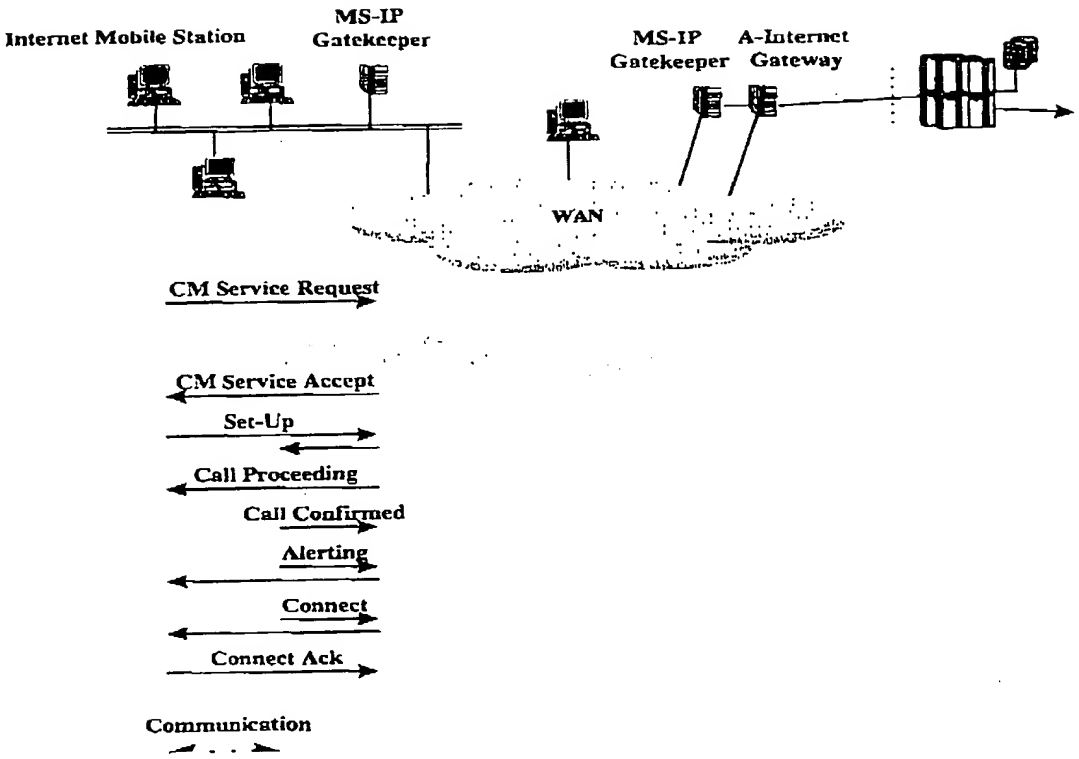

Figure 7. Local Call.

EXTERNAL CALL

External call, both MO and MT, means a normal call to the public network. Call control signalling is routed through A-interface to the cellular network. Authentication, ciphering activation, TMSI re-allocation, and identification enquiry can be performed.

Call control signalling is the same as in previous case except that the signalling is routed to the public network through the Gateway. The Gateway performs protocol conversion between IP network and A-interface. The Gateway may also consists audio transcoding.

Handling of call Set-up message in the Gateway is a special case. Because the MSISDN of the B-subscriber is in the call Set-up message, the Gateway itself has to generate the CM Service Request message and send it to the network when it has received the call Set-up message from the Gatekeeper. The network may perform authentication, ciphering activation, etc. When the network responses with a CM Service Accept message, the Gateway forwards the call Set-up message to the network, and the signalling proceeds normally. If the network responses with a CM Service Reject message, the Gateway rejects the call attempt by sending a Release message to the A-subscriber.

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The external call flow chart has been illustrated in *figure 8*.

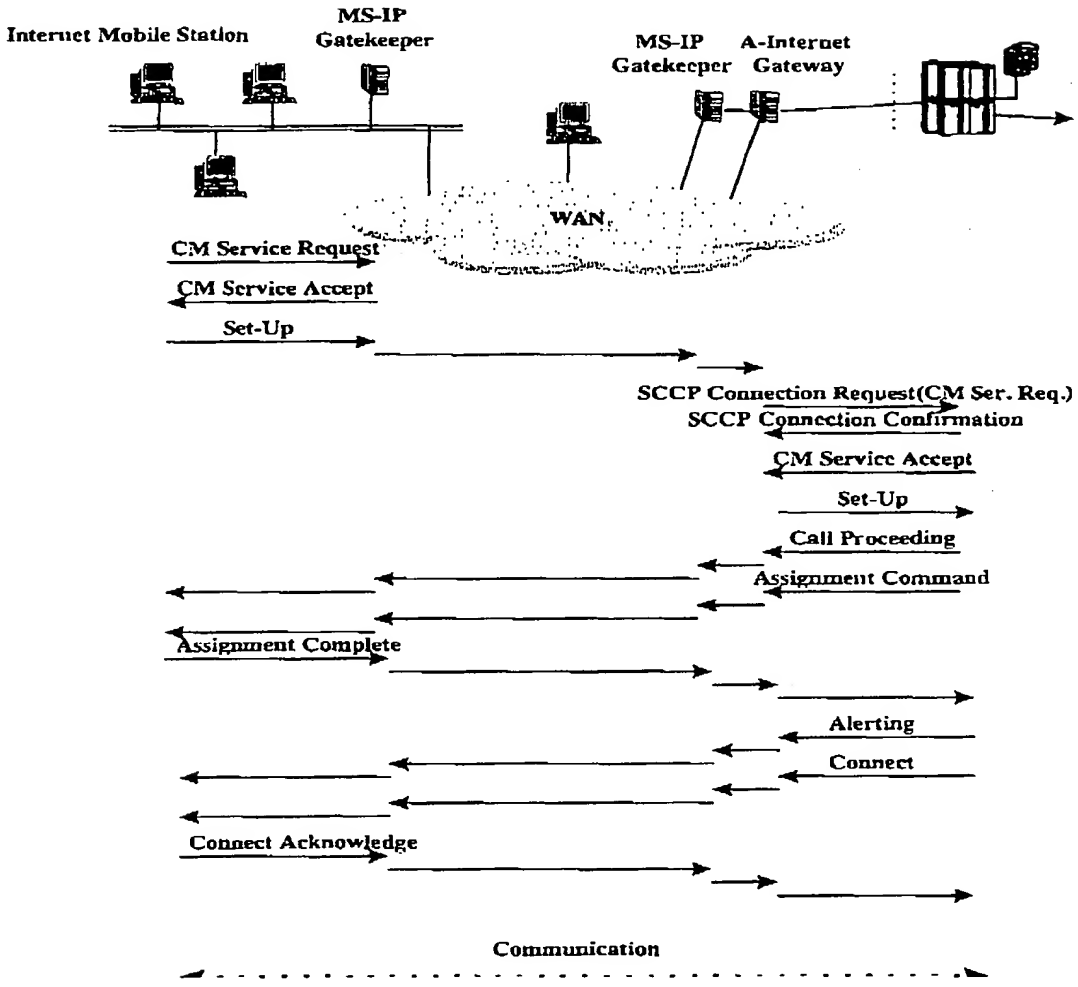

Figure 8. External Call.

CALL TERMINATION

Call termination is controlled by the Gatekeeper which maintains the switching.

In case of A-subscriber terminates the call, the A-subscriber sends a Disconnect message to the Gatekeeper network in order to inform the call termination. The Gatekeeper controlling the switching forwards the message to the B-subscriber. which response with a Release message to the

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Gatekeeper. The Gatekeeper sends a Release Complete message both to the A-subscriber and B-subscriber. The call has been terminated.

The Internet call termination flow chart has been illustrated in *figure 9.*

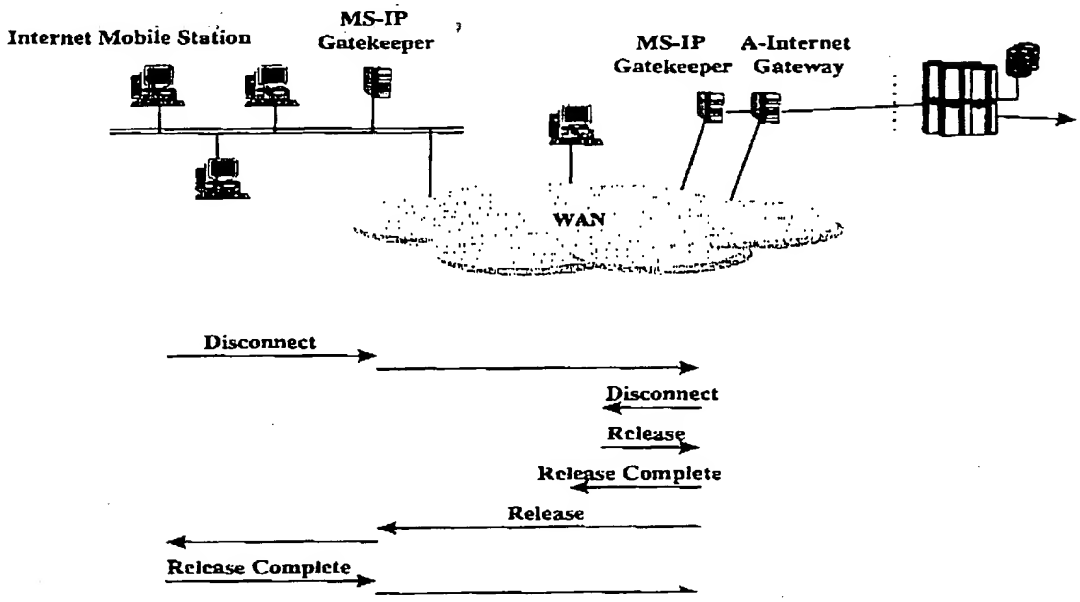

Figure 9. Call Termination.

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